Individual Differences in Warning Perception: The Role of Risk-Taking Propensity

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Abstract

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Warnings are intended to improve safety (decreasing injury, illness and loss) by communicating the presence and nature of a potential hazard and encouraging behaviour that will minimise or avoid a negative outcome. Warnings can be seen as representations of risk, therefore it is likely that an individual's attitude towards risk, their risk-taking propensity, may affect the way they perceive warnings. Establishing this relationship has important practical implications. If high risk-taking propensity can predict non-compliance, then attempts may be made to increase compliance within high risk-takers by tailoring warnings to such individuals. This thesis aims to explore empirically the relationship between measures of risk-taking propensity and warnings, with potential application to the prevention of hazardous behaviours.

Study One investigated the potential relationship between risk-taking propensity and warning perception using an exploratory approach. The results confirmed that various measures of risk-taking propensity predicted warning perceptions, in particular on intentions to comply with the warnings. Studies Two and Three revealed that the relationship between risk-taking and warning perception is domain specific to a certain extent and that it is stronger when contextual information about a hazard is provided. Study Four explored potential underlying mechanisms and revealed that while the mental simulation of positive outcomes of non-compliance was found to be influential, anticipated regret significantly mediated the relationship between risk-taking propensity and intended compliance. Study Five attempted to minimise the discrepancy between high and low risk-takers through warning design manipulation. Despite a strong effect of sensation seeking on intended compliance the warning manipulations implemented had no effect on warning perceptions.

This thesis offers a significant contribution to the literature, by establishing empirically the effect of risk propensity on warnings perception and by providing insight into the theoretical underpinnings of this relationship.

Table of Contents

Abstract III

Table of contents V

Appendices VII

List of tables IX

List of figures XIII

Acknowledgements XV

Author's declaration XVII

***Chapter One* Introduction** 1

1.1 An Introduction to Warning Research 2

Factors affecting the warning process 4

Models of the warning process 15

Demographic factors 22

1.2 An Introduction to Risk-taking Propensity Research 25

Decision Making approach/ Neuropsychological paradigm 25

Psychometric paradigm 32

1.3 Risk-taking and Warnings 40

Demographic Similarities 40

Risk-taking propensity and the warning process 41

1.4 Overview of Experimental Chapters and their Findings 43

***Chapter Two* Study One Measures of risk-taking propensity as predictors of warning perception** 45

2.1 Introduction 45

2.2 Method 53

2.3 Results 59

2.4 Discussion 65

***Chapter Three* Studies Two & Three: Exploring the extent to which the relationship between risk-taking propensity and warning perception is domain specific** 73

3.1 Introduction 73

3.2. Study Two: Recreational Vs. Health & Safety Warnings 79

3.2.1. Pilot Study 79

3.2.2. The Main Study 83

3.2.3. Study Two Discussion 97

3.3. Study Three: Financial Vs. Health & Safety Warnings 100

3.3.1. Pilot study *101*
3.3.2. The Main Study *105*
3.3.3. Study Three Discussion *115*
3.4. General Discussion 118

***Chapter Four* Study Four: Exploring the potential underlying mechanisms behind the relationship between risk-taking propensity and warning perception 125**
4.1 Introduction 125
4.2 Method 134
4.3 Results 139
4.4 Discussion 153

***Chapter Five* Study Five: Minimising the relationship between risk-taking propensity and warning perception through warning design 159**
5.1 Introduction 159
5.2 Pilot study 163
5.2.1 Method *163*
5.2.2 Analysis and Results *164*
5.3 Pre-screen 166
5.3.1 Method *166*
5.3.2 Results *166*
5.4 Main study 167
5.4.1 Method *167*
5.4.2 Results *170*
5.5 Discussion 176

***Chapter Six* General Discussion 181**
6.1 Summary of findings and theoretical implications 182
6.2 Methodological Implications 195
6.3 Future Directions 202
6.4 Conclusions 205

Appendices 207

References 277

List of Appendices

Chapter Two Appendices 209

Appendix 2A The relative predicted hazard levels of each iconic variable combination 209

Appendix 2C An example screen shot taken from the warning task 213

Appendix 2D The Sensation Seeking Scale 214

Appendix 2E The BIS/BAS scale 217

Appendix 2G Risk Behaviour Scale 219

Appendix 2H The Risk Propensity Scale 220

Appendix 2I A Screenshot of the BART 221

Appendix 2J Instructions for the Questionnaire Task 222

Appendix 2K Instructions for the Warning Task 223

Appendix 2L Instructions for the BART 224

Appendix 2M Descriptive statistics for all variables 225

Appendix 2N The inter-correlations between the potential predictor variables of warning perception 226

Chapter Three Appendices 227

Appendix 3A The rank ordered mean risk ratings for both recreational and health/safety behaviours combined 227

Appendix 3B The DOSPERT scales 228

Appendix 3C Study Two warning stimuli 237

Appendix 3D A Comparison of Data from Lab and Internet Studies 239

Appendix 3E Reliability and manipulation checks 241

Appendix 3F Correlations between Subscales and Domains of the DOSPERT 244

Appendix 3G The rank ordered mean ratings for both financial and health & safety behaviours combined 246

Appendix 3H Study Three warning stimuli 247

Appendix 3I Reliability and manipulation checks 249

Appendix 3J Correlations between Subscales and Domains of the DOSPERT 253

Chapter Four Appendices 255

Appendix 4A Warning stimuli 255

Appendix 4B Anticipated regret statements 256

Appendix 4C Screen shots from the warning task 257

Appendix 4D Pre factual coding scheme 259

Appendix 4E Consideration of Future Consequences Scale 263

Appendix 4F The brief for Study Four 265

Chapter Five Appendices 267
Appendix 5A The piloted behaviours 267
Appendix 5B Warning stimuli 270
Appendix 5C Anticipated regret statements 273
Appendix 5D Screen shot of a warning stimulus 274
Appendix 5E Warning task instructions 275

List of Tables

Chapter Two

Table 2.1 Number of Male and Female Participants in Each Age Group 53

Table 2.2 The Iconic Variables Manipulated for Auditory and Visual Warning Stimuli 54

Table 2.3 Correlations between Hazard Perception and Intended Compliance 60

Table 2.4 Correlation coefficients for potential predictors of hazard perception and intended compliance 61

Table 2.5 The regression coefficients for the predictors of warning perception 62

Table 2.6 Means (and Standard Deviations) for Age and Gender 63

Chapter Three

Table 3.1 The Behaviours and Mean Risk Ratings Selected for the Warning Stimuli 82

Table 3.2 The Mean and Standard Error of Design and Contextual features for Hazard Perception and Intended Compliance 88

Table 3.3 Regression coefficients for risk perception and expected benefits scales for each domain of risk behaviour 91

Table 3.4 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Health & Safety Warnings 92

Table 3.5 Regression Coefficients for Risk-taking Propensity as a Predictor of Intentions to Comply with Health & Safety Warnings 93

Table 3.6 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Recreational Warnings 94

Table 3.7 Regression Coefficients for Risk-taking Propensity as a Predictor of Intentions to Comply with Recreational Warnings 95

Table 3.8 Correlation Coefficients for Item-Relevant and Irrelevant Warning Perception to the Five Domains of the DOSPERT Risk Behaviour Scale 96

Table 3.9 The Behaviours and Mean Risk Ratings Selected for the Warning Stimuli 103

Table 3.10 The Mean and Standard Error of Design and Contextual features for Hazard Perception and Intended Compliance 106

Table 3.11 Regression Coefficients for Risk Perception and Expected Benefits Scales for each Domain of Risk Behaviour 109

Table 3.12 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Health & Safety Warnings 111

Table 3.13 Regression Coefficients for Risk-taking Propensity as a Predictor of Intended Compliance to Health & Safety Warnings 111

Table 3.14 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Financial Warnings 112

Table 3.15 Regression Coefficients for Risk-taking Propensity as a Predictor of Intended Compliance to Financial Warnings 113

Table 3.16 Correlation Coefficients for Item-Relevant and Irrelevant Warnings Perception and the Five Domains of the DOSPERT Risk Behaviour Scale 113

Chapter Four

Table 4.1 The behaviours used as warnings stimuli context and their prejudged relative risk levels 136

Table 4.2 The Mean, Standard Deviation and Cronbach's Alpha for all variables 139

Table 4.3 The number of prefactual outcomes identified for each warning 140

Table 4.4 The inter-correlations between the potential predictor variables of warning perception 141

Table 4.5 The regression coefficients for the measures of risk propensity as predictors of positive and negative prefactual thinking 142

Table 4.6 The correlation coefficients for predictor variables and warning perception variables 143

Table 4.7 The regression coefficients for the predictors of warning perception 144

Table 4.8 The regression coefficients for potential mediator variables controlling for sensation seeking 146

Table 4.9 The regression coefficients for potential mediator variables controlling for BIS scores....148

Table 4.10 The regression coefficients for positive prefactual thinking and sensation seeking on anticipated regret....150

Table 4.11 The regression coefficients for positive prefactual thinking and behavioural inhibition on anticipated regret 151

Chapter Five

Table 5.1 The behaviours used as warnings stimuli context and their prejudged relative risk levels 165

Table 5.2 Mean and range of sensation seeking scores for the pre-screen study....166

Table 5.3 The number of participants in each condition group and their mean sensation seeking score 167

Table 5.4 Mean hazard perception scores for sensation seeking group across warning condition 171

Table 5.5 Mean intended compliance scores for sensation seeking group across warning condition 172

Table 5.6 Mean anticipated regret scores for sensation seeking group across warning condition 173

Table 5.7 Correlation coefficients for the dependant variables hazard perception, intended compliance and anticipated regret....173

Chapter Six

Table 6.1 Summary of significant findings across all studies 182

List of Figures

Chapter One

Figure 1.1 The Warning Process (Rogers, Lamson & Rousseu, 2000) 16

Figure 1.2 Communication-Human Information Processing (C-HIP) model (Wogalter, Dejoy & Laughery, 1999) 17

Figure 1.3 An Integrative framework for warning research: Outline of the approach (Edworthy, 1998) 19

Figure 1.4 The Interactive Social-Cognitive (ISC) model (Kalsher & Williams 2006) 20

Figure 1.5 Example of concave and convex utility functions (SEU) 26

Figure 1.6 Prospect Theory utility function (Kahneman & Tversky, 1979) 27

Chapter Three

Figure 3.1 An Example of a High and a Low Hazard Warning for the Same Behaviour 86

Chapter Four

Figure 4.1 Mediation analysis for anticipated regret as a mediator between sensation seeking and intended compliance 147

Figure 4.2 Mediation analysis for anticipated regret as a mediator between behavioural inhibition and intended compliance 149

Figure 4.3 Mediation analysis for sensation seeking as a mediator between positive prefactual thinking and anticipated regret 151

Figure 4.4 Mediation analysis for behavioural inhibition as a mediator between positive prefactual thinking and anticipated regret 152

Figure 4.5 The proposed mediatory relationships between risk-taking propensity and intended compliance. 156

Chapter Five

Figure 5.1 An example of the three experimental versions of the same warning 169

Figure 5.2 Mediation analysis for anticipated regret as a mediator between sensation seeking and intended compliance in the low sensation seeking group 174

Figure 5.3 Mediation analysis for anticipated regret as a mediator between sensation seeking and intended compliance in the high sensation seeking group 175

Chapter Six

Figure 6.1 The proposed mediatory relationships between risk-taking propensity and intended compliance... 188

Figure 6.2 Kalsher& Williams (2006) ISC model modified to include the findings of the current work 190

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Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

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Chapter One

Introduction

Warnings are intended to protect people from hazards. In the realms of hazard control warnings are ideally a last line of defence, after any potential risks have been removed, designed out or guarded against where possible (Sanders & McCormick, 1993). Warnings are designed to improve safety (decrease injury, illness and loss) in three ways (e.g. Wogalter, 2006). First, warnings should communicate the presence and nature of a potential hazard or risk, allowing the receiver to make better informed safety decisions. Second, a warning should cue existing hazard knowledge by reminding the receiver of the presence of a hazard, when pre-existing knowledge is not consciously available. Third, a warning should encourage behaviour that will minimise or avoid a negative outcome. The presence of a warning has been found to increase appropriate safety orientated behaviour for a variety of potential hazards (see Silver & Braun, 1999 for a review).

To date, a wealth of research has been conducted to investigate what makes a warning effective. Such research attempts to describe the warning process and has identified various stages involved in the warning process. For example, for a warning to be effective, at the very least it must be noticed, encoded, understood, and complied with (e.g. Laughery, 2006; Rogers, Lamson, & Rousseau, 2000). These stages are necessary but not sufficient for an effective warning, and fundamentally individuals make a choice to interact with, or avoid, potential hazards.

Decision making theories, for example Expected Utility Theory (Edwards, 1954), suggest that this choice is a result of an individual's evaluation of the severity of a potential hazard and the consideration of expected positive and negative outcomes of alternative actions. With respect to warnings, individuals weigh up perceived level of hazard or risk against the cost and benefits of compliance and non-compliance and act in a way which is expected to produce the most favourable outcome.

Within the warning literature, the factors affecting the decision to comply with a warning have been categorised under two main groups (Rogers et al., 2000). These are warning variables (the physical and contextual characteristics of the warning), and personal variables (the characteristics of the receiver, the individuals the warnings are aimed at). In general, the majority of research has focused on warning variables rather than examining the role of the individual differences. A person's attitudes, beliefs and perceptions of risk associated with the hazard in question have a huge influence over how they will interact with an associated warning. There have been attempts within the literature to model the stages of the warning process and specify how people interact with warnings. These models differ in the degree to which they consider this cost-benefit analysis and are discussed within this chapter.

In essence, non-compliance with a warning is a form of risk-taking behaviour. To engage with a hazard in an unsafe manner is to take a risk. Individual differences in risk-taking propensity and risk perception have been studied at length in relation to a multitude of risks. Many constructs, scales and tasks have been devised to measure a person's propensity to engage in risk-taking behaviour. Little research has considered the role of individual differences in risk-taking propensity in relation to warnings. The aim of this chapter is to review both warning literature and risk-taking propensity literature, to investigate whether findings from risk-taking research may inform warning design and implementation.

1.1 An Introduction to Warning Research

Within warning research, the perception of the risk involved or expectation of adverse consequences that arises from engaging unsafely with a particular hazard is known as hazard perception (Slovic, Fischhoff, & Lichtenstein, 1979). Hazard perception is based on evaluations of the relative impact of both the likelihood of an adverse event happening and the severity of the consequences. These factors interact to produce the level of perceived hazard, for example a potential hazard may be perceived as being extremely severe yet have little effect on compliance as the probability of the adverse event occurring is very small. While both perceived severity and probability of adverse outcomes can influence hazard perception, it is suggested that severity is the primary influence on hazard perception and has been found to account for approximately 80% of the variance of an individual's motivation to read warnings (Wogalter, Brelsford, Desaulniers, & Laughery, 1991).

Hazard perceptions have been widely studied within warning research. The higher the individual's perception of a hazard, the more likely people will be to notice, read and to comply with an associated hazard (e.g. Friedmann, 1988; Otsubo, 1988; Wogalter, Jarrard, & Simpson, 1994a). As previously mentioned hazard perceptions are considered by the individual against the potential costs and benefits of engaging (or not engaging) in the appropriate safety behaviour. Research has found that when the costs of compliance with a warning are high, people are less likely to do so. When protective equipment, like safety goggles, is made readily available, the cost of complying with warnings instructing participants to wear such equipment is relatively low and high rates of compliance were demonstrated (Dingus, Hathaway, & Hunn, 1991; Wogalter, Allison, & McKenna, 1989). Alternatively, it was found that if the cost involves walking into the next room to retrieve such items compliance was greatly reduced. This effect has been replicated with a wide range of hazards (see Rogers et al., 2000). The costs of compliance can be related to many factors for example monetary costs, effort (e.g. distance to be travelled) and social costs (e.g. looking stupid). Edworthy (1998) defines these as cost variables which include anything which decrease the likelihood of safe behaviour and factors which increase such behaviour are defined as task variables, for example hazard perception. As task variables are weighed against cost variables it follows that the higher an individual's perception of hazard, the higher costs of compliance they will be willing to endure. If a warning is present, it can influence the receivers' perception of cost and task variables. It is important to note that decisions may also take account of the probability of a negative outcome even if a warning is complied with and the appropriate behaviour is carried out, therefore perceptions of the efficacy of the safety behaviour are relevant (DeJoy, 1999).

There is a wealth of research which has resulted in guidelines for effective warning design. For example, Wogalter, Jarrard, & Simpson (1992a) advised that the design of visual warning labels should consist of four main components: 1. a signal word, 2. a statement about the nature of the hazard, 3. a statement about the negative consequences of the hazard and 4. instructions of how to avoid potential negative consequences. This format is also recommended by the American National Standards Institute (ANSI Z535.2 2002).

Factors affecting the warning process

As previously mentioned, the way in which warnings influence decisions is multifaceted. Both warning variables and personal variables play a role at each stage of the warning process. Laughery & Wogalter (2011) have summarised the most important findings from the extensive warning research in a three stage model: Attention, Knowledge and Compliance (AKC). The attention stage includes research on the noticing, attention attracting and maintaining qualities as well as the encoding of a warning. The knowledge stage refers to comprehension, memory, evaluations and perceptions of warnings and associated hazards and the compliance stage refers to factors which affect intentions to comply, motivations, decision-making and behaviour. The present review of factors affecting the warning process will be structured under these three stages. Whilst warnings can be delivered through a variety of sensory modalities, for example, recent attention has fallen on the potential of tactile and olfactory warnings (e.g Ho, Santangelo, & Spence, 2009). Research has traditionally focused on the effectiveness of visual and auditory warnings. The studies presented within this thesis focus on these two modalities (in particular visual warnings), therefore only literature relating to visual and auditory warnings will be discussed here. The following section is not an exhaustive list of the factors which affect the efficiency of warnings, but a discussion of some variables found to be relevant to the warning process from a design and implementation perspective as well as characteristics of the receiver.

Attention

There are obvious aspects of the warning design which affect the extent to which a warning will be noticed, read and encoded. For example the size of a warning affects its noticeability, Barlow and Wogalter (1991) found larger warnings were perceived as more noticeable and easier to process. The choice of signal word can also affect attention to a warning, for example the word 'danger' was rated as more attention grabbing than 'caution' (Wogalter, Kalsher, Frederick, Magurno, & Brewster, 1998). Similarly the shape of a warning also has an influence, Riley, Cochran & Ballard (1982) found that the perceived likelihood of attracting attention was higher for certain shapes (e.g. an upturned triangle) than others (e.g. a circle). However it is important to note that the former studies did not measure the actual extent to which warnings were noticed, instead they measured participants' ratings and perceptions of the *likelihood* of noticing a warning. The time taken to notice warnings holds more validity as measure of the extent to which a warning will attract attention. Research using this methodology has found that warnings containing a symbol or pictorial were noticed more quickly than warnings without and that a pictorial combined with other design features reduced noticing times (Laughery & Young, 1991; Young, 1991). The presence of a pictorial has also been found to increase the likelihood that a warning is read and encoded (Kalsher, Pucci, Wogalter, & Racicot, 1994; Kalsher, Wogalter, & Racicot, 1996).

The format and layout of the text within a warning has been shown to have significant effects. Text attracts attention better if it is 'chunked' or formatted in bullet points (Laughery & Wogalter, 2011). Similarly the size and font of the message has an impact on the readability of a warning. For example, larger writing is perceived to be more readable (Silver, Kline, & Braun, 1994). Silver and Braun (1993) found participants perceived Helvetica font to be more readable followed by Times and Goudy. Bold font was also perceived to be more readable than regular font.

The presence of colour in a warning has been found to increase the extent to which it is noticed, Young (1991) found warnings were more noticeable when printed in red compared to black, however, Braun and Silver (1995) found black on white to be more salient. It is important however to consider the warning context, as if the colour of a warning is similar to the background on which it is placed, noticeability is decreased (Laughery & Wogalter, 2011). The placement or location of a warning sign or label can affect its noticeability in other ways. Warnings placed on the front of products are most noticeable (Godfrey et al., 1991). Similarly, if the warning is placed in such way that the receiver must interact with the warning (for example if the warning must be removed before a product can be accessed) it is more likely to be noticed (Duffy, Kalsher, & Wogalter, 1993; Frantz & Rhoades, 1993). If a warning is placed against a noisy or cluttered background the warning must 'compete' for attention therefore the noticeability of the warning is diminished and compliance is reduced (Wogalter, Kalsher, & Racicot, 1993). A similar effect is found for auditory warnings, although the variability of sound levels in an environment makes this a complex and important factor in auditory warning efficacy (Edworthy & Adams, 1996). If the warning is too quiet, it will not be noticed due to masking effects of other sounds, too loud and it will lead to counterproductive behaviour (such as distraction or the warning being disabled). Tonal auditory warnings that are acoustically complex (i.e. containing multiple harmonics) are less susceptible to masking and are more easily located (Edworthy & Adams, 1996). Also irregular rhythmic patterns have been found to capture attention effectively (Suied, Susini, & McAdams, 2008).

Receiver characteristics which affect the extent to which an individual will notice a warning include visual and hearing impairments (Laughery & Brelsford, 1991). Indeed, Watanabe, Gilbreath, and Sakamoto (1994) found that some warnings in their study could not be read by individuals with less than 20/20 vision, greatly decreasing their chance of being encoded and therefore complied with. Fatigue levels and attention focus have also been suggested to be related to warning noticeability (Ayres et al., 1989; Wogalter, Kalsher, & Racicot, 1992b) as has distraction (Laughery & Wogalter, 2011). Memory, particularly working memory load, has been suggested to influence the processing of warnings (Ayres et al., 1989; Purswell, Krenek, & Dorris, 1987; Wogalter et al., 1992b). Although such factors seem intuitively relevant to the warning process, the manner and extent to which they are related is less clear and requires further investigation (Rogers et al., 2000).

Familiarly with a hazard has also been found to be related to the extent to which someone will notice a warning, however there have been inconsistent findings within this area. Some researchers have found that increased familiarity led to increased awareness of warnings (Greenfield, Graves, & Kaskutas, 1993; Greenfield & Kaskutas, 1993). For example, Greenfield and Kaskutas (1993) found that people who drank alcohol more regularly were more likely to recall warnings on drink containers. This may be explained by the fact that they come into contact with the containers more than infrequent drinkers, and therefore are more likely to notice and remember the warning. However, generally the extent to which warnings are searched for and subsequently read decreases with familiarity. This effect is thought to be driven by hazard perceptions. Naturally, the extent to which an individual actively searches for a warning will affect the extent to which a warning is noticed and the more dangerous an individual perceives a hazard to be, the more they will search for warnings (Godfrey, Allender, Laughery, & Smith, 1983). It has been well established that the more benign experience someone has with a hazard the less risk they perceive from that hazard (Godfrey et al., 1983; Godfrey & Laughery, 1984; Leonard, Hill, & Karnes, 1989; Wogalter et al., 1991). If you engage with a hazard frequently without experiencing any negative consequences, you are likely to believe the hazard to be less dangerous than someone with no experience of the hazard (or someone with experience of negative consequences from the hazard). In turn you may be less likely to look for and therefore notice an associated warning (LaRue & Cohen, 1987; Wogalter et al., 1991). Supporting research by Otsubo (1988) has found that participants who had no experience with the hazardous products were more likely to search for and read warnings than participants who had no negative experience with the products.

Habituation is offered as another explanation for the familiarity effect (DeJoy, 1999). The more a warning is encountered, the less an individual may respond to it. As we are frequently exposed to many warnings in the environment, we may stop attending to them so rapidly.

Thorley, Hellier and Edworthy (2002) found that participants show diminished skin conductance responses to warnings with multiple presentation in laboratory situations.

Knowledge

After a warning has attracted and maintained attention sufficiently for it to be encoded, a successful warning should influence the receiver's knowledge (Laughery & Wogalter, 2011). This requires them to understand the information and incorporate it into their expectations of the potential outcomes. Recently, the notion that these processes are separate stages has been supported. Ma, Jin and Wong (2010) found the evidence that attending to and evaluating warning signal words requires different neural systems, using Event Related Potential data from Chinese participants.

Design features of the warning can affect the extent to which it is understood for example the textual information displayed by the warning. Clear, specific and detailed information should increase the receiver's understanding of a potential hazard (Laughery & Smith, 2006). Also the explicitness of the warning can affect comprehension, (Laughery & Stanush, 1989). Comparatively the receiver's vocabulary can affect understanding, for example Leonard, Creel and Karnes (1991) found that participant understanding of the wording of warnings varied considerably. While the majority of participants understood the term 'flammable gas' very few understood the meaning of 'radioactive' and 'combustible'.

One might expect that the use of pictorials would increase warning comprehension, as pictorials can convey meaning quickly and effectively (Laughery & Wogalter, 2011). However there are differences in people's level of symbol comprehension. Bruyas, Pauzie, and Adham (1997) revealed that older participants found it more difficult to comprehend symbols (purportedly due to decreased memory for the meanings of the symbols). Similar results have been found by a number of researchers (e.g. Easterby & Hakiel, 1981; Lesch, 2004). Another receiver characteristic that affects warning comprehension is reading ability (Wegner & Girasek, 2003).

As the knowledge stage includes expectations and beliefs (Laughery & Wogalter, 2011), an individual's hazard perception (the evaluation of negative consequences from a hazard) is a major influence at this stage. Hazard perceptions are affected by many of the design features already discussed.

'Arousal strength' is a term proposed by Wogalter and Silver (1990a) to subsume the noticeability, likelihood and severity of negative consequences that is conveyed by a warning. The arousal strength of a signal word has been found to be directly and consistently related to hazard perceptions of warnings (e.g. Bresnahan & Bryk, 1975; Dunlap, Granda, & Kustas, 1986; Leonard et al., 1989; Leonard, Karnes, & Schneider, 1988). For example the word 'Danger' has been consistently found to imply high hazard, and 'Notice' low hazard, however, some inconsistency has been found for the word 'Warning' and 'Caution' (Chapanis, 1994; Kline, Braun, Peterson, & Silver, 1993; Wogalter et al., 1992b; Wogalter & Silver, 1990a). Despite this disparity, the relationship between hazard perception and signal word has been found to be relatively stable using a variety of methodologies (Chapanis, 1994; Hellier, Wright, Edworthy, & Newstead, 2000).

The colour of the warning has been found to affect hazard perception for warnings (Kline et al., 1993). Black and white is perceived to convey the lowest level of hazard (Wogalter et al., 1998) and red is perceived to convey the highest level followed by orange, black, green and blue (Braun & Silver, 1995). Similar results have been found by a number of researchers (e.g. Bresnahan & Bryk, 1975; Chapanis, 1994; Silver & Wogalter, 1989) and this pattern has been found to be fairly consistent across cultures (Dunlap et al., 1986).

The shape of a warning symbol can affect hazard perceptions. For example, pointed or unstable looking shapes yield higher hazard ratings. Riley, Cochran & Ballard (1982) found that an upturned triangle was rated as more appropriate for warnings. This was followed by diamond and hexagonal shapes. Similarly, pointy shapes like octagons and diamonds have found to be rated more hazardous than squares or circles (Collins, 1983). Design variables have also been found to interact. The combination of shape and colour of warnings have been found to produce an additive effect (Braun & Silver, 1995; Wogalter et al., 1995b). Adams and Edworthy (1995) investigated the combination of colour and font size (amongst other variables) and found such factors trade off, for example a warnings with the fonts size of the signal word 'warning' in monochrome must be round twice the size of the equivalent warning in red to convey the same amount of hazard.

For auditory warnings, design features can be manipulated to produce different levels of hazard in the same way, however the term 'urgency' is used to refer to the temporal immediacy of a response to a warning (e.g. Hellier, Edworthy, & Dennis, 1995). For tonal warnings, higher pulse frequencies are perceived as more urgent than low pulse frequencies (Edworthy, Loxley, & Dennis, 1991). Syncopated rhythms have been found to be perceived as lower in urgency than regular rhythms. Acoustically complex tonal warnings are perceived to be more urgent than simple warnings, however delayed harmonics are perceived to be less urgent than non-delayed (Edworthy et al., 1991). The inter-pulse interval is the duration of silence from the offset on one pulse to the onset of the next, this relates to how fast the warning sounds. The faster the speed of the pulses within a burst (the shorter the inter-pulse interval), the more urgent the warning is perceived to be (Edworthy et al., 1991; Haas & Casali, 1995). Similarly, for verbal auditory warnings, the faster the message is spoken the more urgency is perceived. Simpson & Marchinda-Frost (Simpson & Marchinda-Frost, 1984) found faster response rates for faster spoken messages however, verbal warnings which are too fast decrease comprehension (Slowiaczek & Nusbaum, 1985).

Informational features of a warning (be it an auditory or visual warning) also affect hazard perceptions. For example, the wording of the information has an effect in various ways. The explicitness of a message can influence the perception of the severity of a hazard (e.g. Laughery, Vaubel, Young, Brelsford, & Rowe, 1993). Naturally warnings which explicitly outline the severity of injury associated with a hazard are rated as more hazardous than warnings which are not explicitly worded (e.g. Edworthy et al., 2001; Wogalter & Barlow, 1990).

The tone of the message has an impact, for example research has focused on definite messages (‘Smoking is dangerous’ or ‘Do not swallow’) vs. probabilistic messages (‘Smoking may be dangerous’ or ‘Avoid swallowing’). Definite messages are seen as more appropriate for communicating risk (Edworthy, Hellier, Morley, Grey, & Lee, 2004) and have been found to increase hazard perceptions (Costello, Hellier, Edworthy, & Coulson, 2002).

As previously discussed, an individual’s familiarity (knowledge of and experience with) a potential hazard is a prominent factor in the way in which it will be processed through beliefs and expectations. Leonard, Matthews, and Karnes (1986) found perception levels are affected by previous experience with similar situations, and this experience can be vicarious; for example, through the media. When people interact with a hazard unsafely without experiencing any adverse consequences they tend to become less apprehensive in future interactions. Such benign experience with a hazard leads to lower hazard perception, due to a decrease in the individual’s perception of the likelihood that adverse consequences will occur. It has been found the more familiar an individual is with a hazard, the lower their perception of the risks involved with that hazard (Godfrey et al., 1983; Goldhaber & deTurck, 1988; Karnes, Leonard, & Rachwal, 1986; Patterson, Hunnicutt, & Stutts, 1992).

Cognitive biases may also be relevant to the warning process. Optimistic bias is the tendency people have for unrealistic optimistic attitude (Weinstein, 1980). Humans in general appear to be deficient at judging levels of personal risk compared with judging levels of risk to the population at large (Lichtenstein, Slovic, Fischhoff, Layman, & Combs, 1978). It appears that people do not think specific risks apply to them as much as they do to others. Those who do not comply with warnings even when the negative consequences have been made explicit, may do so as believe that they are more skilled, and more in control of the situation than others. Friedmann (1988) found non-compliant participants reported that they believed that the adverse consequences would not happen to them and that they were able to interact with the hazards in a safe manner without following the prescribed safety behaviours. The presence of a warning can reduce the extent of this optimistic bias. Bohannon and Young

(1993) found that the optimistic bias held by adolescents towards the risks of alcohol was reduced when a warning was present on alcohol advertisements.

Another cognitive bias which is suggested to relate to how people evaluate the risk and benefits is the availability heuristic (Kahneman, Slovic, & Tversky, 1982) which holds that decisions are biased by the extent to which the outcomes are imaginable, or the ease of which they can be mentally simulated. Lichtenstein et al. (1978) found that although hazard perceptions of numerous risks were found to be rated consistently across participants, they were not consistent with public health statistics. The participants greatly overestimated infrequent risks (homicides, fires and floods for example) and underestimated frequent but less sensationalised risk such as asthma and diabetes. They concluded that the sensationalised risks were more available in the minds of the participants due to media over exposure and were therefore more easily recalled. This bias has also been observed for domestic hazards by Wogalter, Brems and Martin (1993). These authors also manipulated the amount of time given to participants to make a response (assuming that in the hurried condition participants would rely more heavily on the availability heuristic, discussed later), although there was no difference in risk estimates, participants given additional processing time indicated higher precautionary intent than those who were hurried, suggesting they relied less heavily on heuristics.

Trait-based individual differences like safety locus of control and self-efficacy have been suggested to be relevant to the warning process (Smith-Jackson, 2004). An individual with an external locus of control may believe themselves to have less control over a hazardous situation, than an individual with an internal locus of control (e.g. Vaughan, 1993). Similarly individuals with low self-efficacy may believe they are not capable of carrying out the necessary safety behaviour or they may believe that the recommended action is not effective for reducing the effect (Weinstein, 1993). Another belief that is suggested to be relevant to the warning process is an individual's level of trust in the source of the message (Horst, McCarthy, Robinson, McCarthy, & Krumm-Scott, 1986). For example, an individual with low trust in the government may be less likely to comply with a governmental warning as they may not believe the advice to be accurate.

Compliance

Hazard perception is consistently and highly related to warning compliance and compliant intentions (e.g. Friedmann, 1988; Vredenburgh & Cohen, 1995; Wogalter & Barlow, 1990) therefore, many of the factors which affect hazard perceptions also affect compliance, motivation and intentions to comply. For example, the colour of the warning has been found to affect increased behavioural compliance (e.g. Kline et al., 1993). Wogalter et al. (1987) found that the presence of colour (as opposed to black and white) on a warning sign above a drinking fountain instructing that the water must not be drunk due to contamination, increased compliance from 12% to 67%. Also Braun and Silver (1995) found red warning labels resulted in higher levels of compliance than black or green warnings.

The presence of an icon or pictorial has been found to increase the likelihood that a warning will produce compliance (Jaynes & Boles, 1990; Wogalter, Begley, Scancorrelli, & Brelsford, 1997). However, there appears to be no effect of the type of pictorial on compliance. Friedmann, (1988) found no difference between proactive icons (images displaying correct behaviour) and reactive images (images displaying the consequences of non-compliance).

For auditory warnings, researchers have recently demonstrated the effect of inter-pulse intervals on behavioural reaction times and found participants reacted faster to warnings with shorter inter-pulse intervals (Suied et al., 2008). Similar effects of speed have been found for speech warnings; Simpson and Marchinda-Frost (1984) found faster response rates for faster spoken messages.

The wording used in the warning messages has been found to affect compliance rates in various ways. For example, the explicitness of the wording of the consequences and the procedural instructions can affect compliance rates. The more explicitly worded the consequence statement of the warning is the more it will be complied with (e.g. Edworthy et al., 2001; Laughery & Smith, 2006; Wogalter & Barlow, 1990). Laughery, Rowe-Hallbert, Young, Vaubel and Laux (1991) found that explicitly worded consequence statements (e.g. 'If you drink while you are pregnant, your child may be born with Foetal Alcohol Syndrome and need institutionalization') lead to higher intentions to comply than statements that were not explicit (e.g. 'Mixing alcohol and medicine can be life-threatening'). Frantz (1994) found warnings with explicit instructions (e.g. 'Wear rubber gloves and protective glasses') lead to higher behavioural compliance than non-explicit instructions (e.g. 'Avoid contact with eyes and skin'). Also, Taylor and Bower (2004) found warnings that outlined how compliance would lead to the desired outcome increased compliance rates. Similarly, Edworthy et al. (2004) found the use of personal pronouns (e.g. 'You must wear gloves') in warnings produced higher compliance than warnings which did not contain personal pronouns. Wogalter, Racicot, Kasher and Simpson (1994b) further personalised warnings by including the receiver's name in the warning and found significantly higher compliance than when using impersonal warnings. It is suggested that the receiver perceives the warning to be more relevant to them under these conditions, perhaps reducing optimistic bias.

The way in which the warning message is framed has been found to lead to different levels of compliance. Within the warning literature negatively framed messages (which outline what behaviours must be avoided) have been found to increase willingness to comply compared with positively framed messages (that outline what behaviours must be engaged in). For example DeTurck and Goldhaber, (1989) found warnings which used the word 'never' produced higher willingness to comply than 'always'. There is a wealth of research into framing effects regarding health messages, which have found caveats within this area, for a review see Rothman and Salovey, (1997).

Given the relationship between familiarity and compliance it is not surprising that familiarity with a hazard has been found to decrease compliance as well as hazard perception and information seeking (Goldhaber & deTurck, 1988; Otsubo, 1988; Wogalter, Barlow, & Murphy, 1995a). Indeed, Wogalter et al. (Wogalter et al., 1991) found that familiarity with a hazard explained little variance in compliance above that which was explained by its effect on hazard perception. Naturally, the opposite effect can be produced by experiences which are not benign. Otsubo (1988) found that the participants who were familiar with specific tools and still displayed high compliance with associated warnings had been previously injured by such tools. Edworthy, Hellier, Morley, Grey, and Lee (2004) found that experience can interact with warning variables to produce different levels of compliance. For example, experienced users of pesticides displayed higher compliance with warnings when presented within a supplemental leaflet.

Another factor which has been found to affect compliance is social influence or modelling (e.g. Edworthy & Dale, 2000; Olson, Grosshuesch, Schmidt, Gray, & Wipfli, 2009). People often behave in a way that is consistent with those around them. Edworthy & Dale (2000) found that the presence a compliant confederate raised participants' compliance whereas a non-compliant confederate decreased compliance rates. Also Racicot and Wogalter (1995) found compliance with warnings was increased when a video demonstration of appropriated behaviour was used.

It is clear from the research presented that the warning process is complex and many factors affect stages of the warning process differentially. Therefore researchers have attempted to create integrative models of the warning process. While there have been many models proposed over the years and some borrowed from other areas of psychology (Cameron & Dejoy, 2006; Lehto, 2006a) four of the most recent and prominent models of the warning process are introduced here. The models are presented in order of the extent to which they consider the role of the recipient of the information.

Models of the warning process

Firstly, Rogers et al. (2000) developed an integrative model from an extensive literature review focusing on visual warning research with a view to direct future warning research and design. They describe the warning process as involving four components: notice, encode, comprehend, and comply. The researchers do not assume that these components are necessarily linearly related and acknowledge they may interact with and 'overlap' each other;

however they have not attempted to incorporate this directly into their model. They define the factors affecting the components into two broad categories, warning variables and personal variables and stress that factors within the categories can affect more than one of the four components (and other factors). See Figure 1.1 for an illustration of the model.

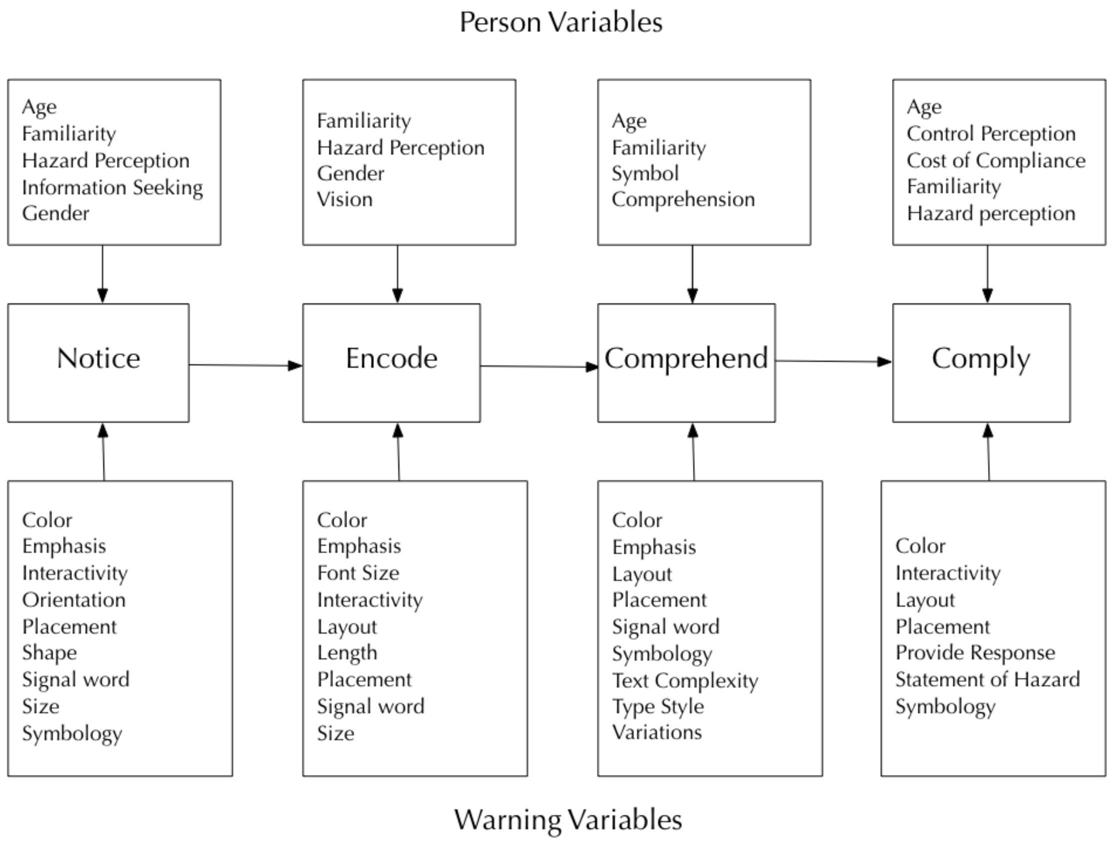


Figure 1.1. The Warning Process (Rogers, Lamson & Rousseu, 2000)

The model synthesises the literature and allows the researcher to identify potential factors which have been suggested, as well as demonstrated to affect the warning process. It is therefore a useful tool for research and their literature review on which the model is based outlines where further research is needed by emphasising where factors have not been adequately empirically verified. The model proposes that the personal variables, that is receivers' expectations, beliefs and motivations etc. are a group of factors which affect the four stages differentially however, due to their integral role in the decision making process, they may be better conceived as a stage of the process itself.

Secondly, Wogalter, DeJoy and Laughery (1999) proposed a model of the warning process called the Communication-Human Information Processing model (C-HIP) which combined existing theoretical frameworks (Laughery & Wogalter, 1997; Trumbo, 1999). The three main components of this model are: a) the source (the transmitter of the warning message), b) the channel (how the message is transmitted, the message itself and the medium through which it is transmitted), and c) the receiver (the individuals for whom the message is intended). The authors propose that there are also several subcomponents which occur at the level of the receiver; Attention/noticeability, comprehension and memory, attitudes and beliefs, motivation and behaviour. See Figure 1.2 for an illustration of the model.

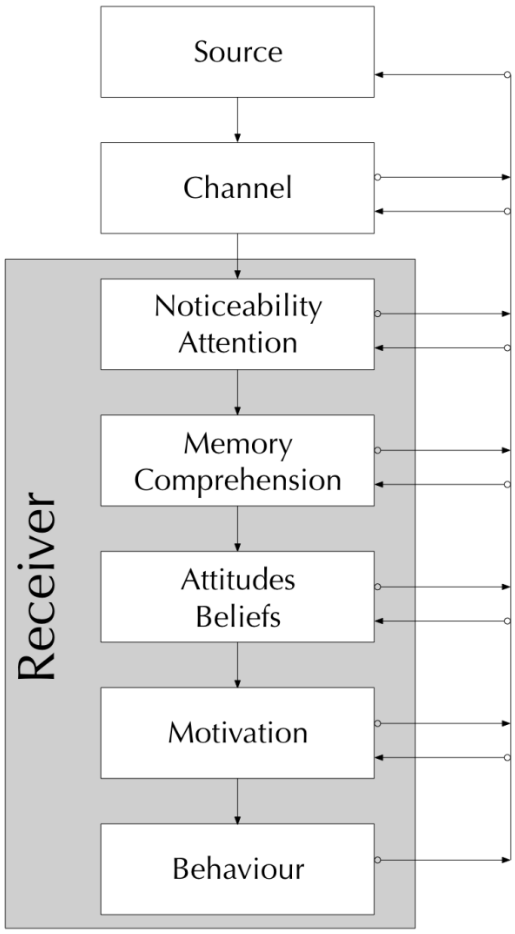


Figure 1.2 Communication-Human Information Processing (C-HIP) model (Wogalter, Dejoy & Laughery, 1999)

The model allows different factors to influence each component differently, and surpasses Rogers, et al.'s (2000) model by explicitly incorporating the non-linear nature of the process into the model. If warning information is successfully processed at each stage it ‘flows’ to the next, however if unsuccessful it ‘bottlenecks’ and blocks the flow from one stage to the next. While each stage is a precursor for behavioural compliance, the authors recognise that later stages can feedback and influence earlier stages and have incorporated this into the model.

The C-HIP model has more applications than the model proposed by Rogers et al. (2000) as not only does it organise the warning literature and inform future design, the researchers argue it can been used as a diagnostic tool for discovering why a specific warning is ineffective by identifying at which stage the bottleneck occurs. For example, if a warning is noticed and attended to it but not understood, the warning is not processed through the other stages. If the warning is understood, it may not be congruent with a receiver’s beliefs that the hazard is actually a threat and therefore still may not lead to behavioural compliance.

Thirdly, Edworthy (1998) proposes an integrative framework within which decision-making theories (e.g. Subjective Expected Utility Theory, Edwards, 1954) are an integral part. The model places warnings within a framework which explains the way people behave towards a hazard in general. The decision to interact with a potential hazard is conceptualized as a trade-off between the perceived benefits and costs of engaging in such safety behaviour. When faced with a hazard, there are cues from the hazard itself which affect/inform this utility judgement, by providing information about the nature of the hazard so that the individual can weigh up the costs and benefits of engaging in safety behaviour. See Figure 1.3 for an illustration of the model.

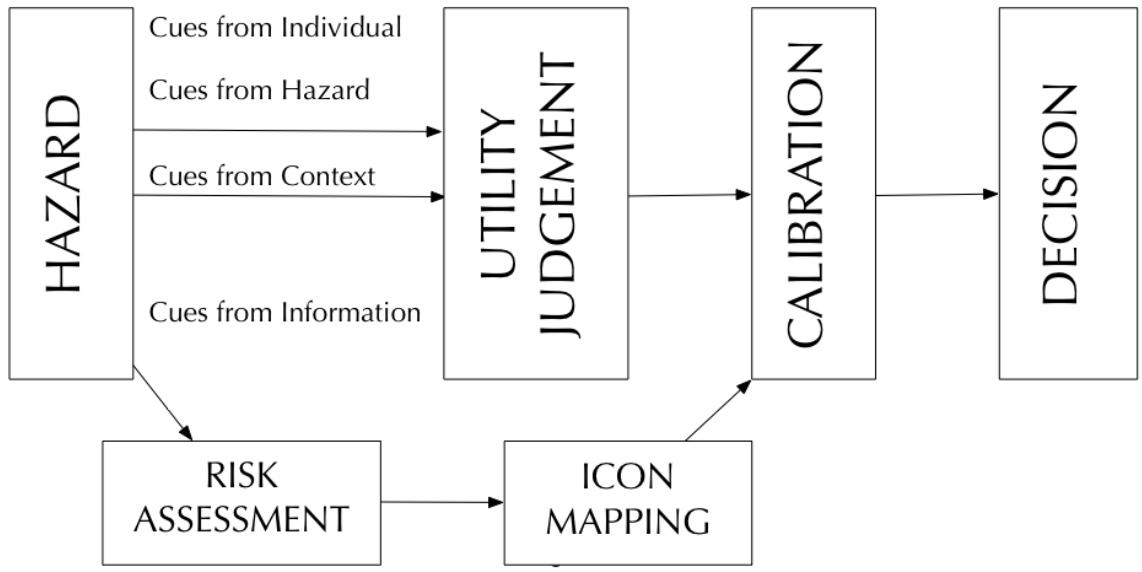


Figure 1.3. An Integrative framework for warning research: Outline of the approach (Edworthy, 1998)

Edworthy broadly categorises three factors influencing the utility judgement; cues from the hazard (e.g. sharp edges, odour, colour), cues from the individual (e.g. familiarity, skill, mood) cues from the context (e.g. social environment, peer pressure, setting a good example). When a warning is present cues from the information conveyed by the warning allow the individual to calibrate their judgement before making their decision to interact with a hazard in a certain way. This information can relate to the nature of the hazard or how to mitigate its effects or it can be iconic for example, the signal word and colour provide information about the level of hazard present. Warnings further inform the utility judgement by clarifying the nature of the hazard and providing strategies of mitigation. Indeed, Laughery, Laughery, Lovvoll and McQuilkin (1997) found that warnings are more effective when the hazard is not obvious. Ideally warnings should be designed in line with risk assessments so that the level of hazard indicated by the warning can inform the individual as accurately as possible. Icon mapping (also hazard or urgency mapping depending on warning modality) refers to manipulation of the features of a warning in a manner which minimises discrepancy between the level of hazard implied by the warning and the level of the hazard itself. The better a hazard is matched, the more accurately the individual can judge the level of hazard and decide whether or not to comply (Hellier et al., 2000; Wogalter & Silver, 1990a).

The model emphasises that a warning cannot override the utility judgements but is intended to calibrate decisions, prior to behaviour for example a warning may confirm the decision already made by an individual. It also places more emphasis of the role of the hazard itself in influencing decisions than the C-HIP model which may be an important factor in behavioural compliance.

Fourthly, Kalsher and Williams (2006) propose a theoretical framework which also places more importance on the role of the receivers' decision making and situational influences. The Interactive Social-Cognitive (ISC) model overlays the C-HIP model (Wogalter et al., 1999) and includes social and cognitive theories to explain how a combination of personal and situational variables bring about compliance. The researchers argue that the C-HIP model is reliant on communication and information processing theories and as such excludes other theoretical perspectives relevant to behavioural compliance. See Figure 1.4 for an illustration of the model.

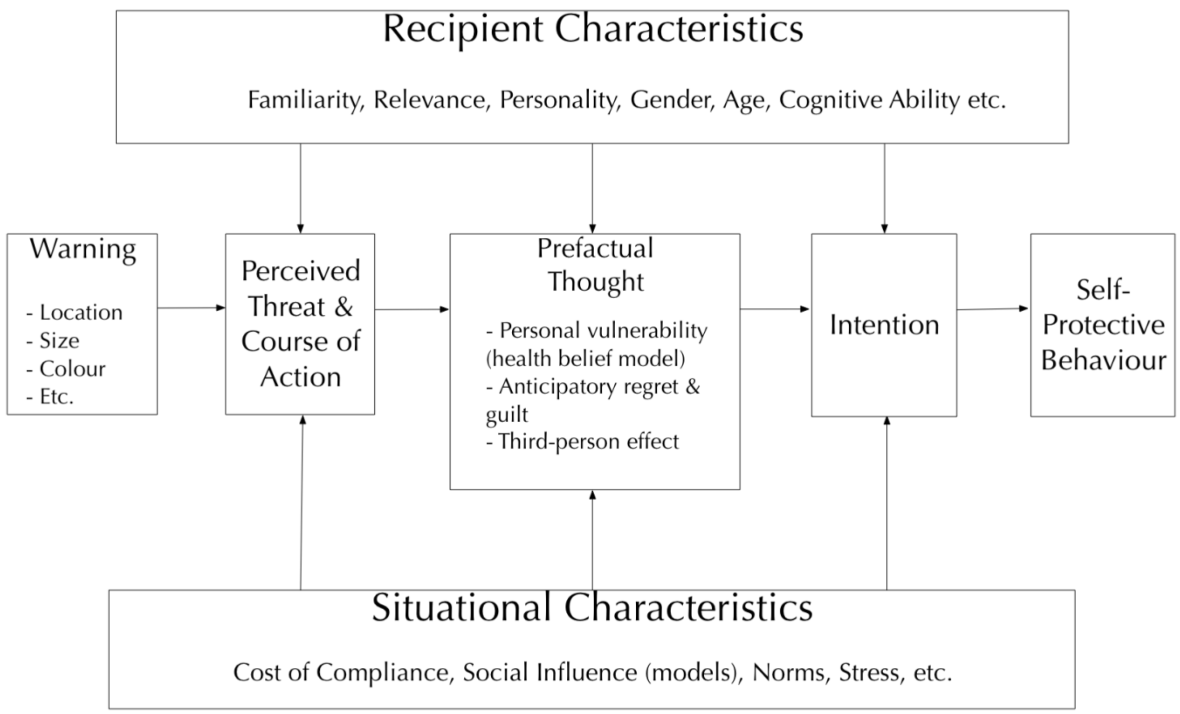


Figure 1.4 The Interactive Social-Cognitive (ISC) model (Kalsher & Williams 2006)

The way an individual views the context of a hazardous situation and the extent to which the situation reflects their beliefs and expectations, influences their decision to comply with a warning, therefore the ISC model incorporates various existing psychological theories and concepts. The prefactual thought stage of the model is similar to the motivation stage of the C-HIP model. Prefactual thinking is defined as the mental simulation of possible future outcomes (Sanna, 1996) and is an anticipatory motivation. Prefactual simulation of negative consequences is associated with negative anticipatory emotions (e.g. anticipated regret and guilt) which motivate the individual to produce behaviour which minimises the chance of experiencing that emotion (Sanna). The potential of prefactual thought to influence the warning process is discussed in further detail in Chapter Four, however Kalsher and Williams (2006) considered various social cognitive theories that may be applied to compliance under this stage, presumably as they involve thinking about possible outcomes. For example, the Health Belief Model (Rosenstock, 1974) which assumes that individuals will engage in safety-related behaviour if they believe their health is threatened and that the prescribed safety behaviour will actually prevent the threat. The Theory of Planned Behaviour (Ajzen, 1991) states that the best predictor of behaviour is intention, which is in turn influenced by attitudes, subjective norms and perceived ability to carry out the behaviour. The third person effect (Adams, Bochner, & Bilik, 1998) is the common belief that other people are more susceptible to a range of phenomena than oneself, in this case the threat from hazards, comparable with optimistic bias. Also relevant here is Reactance Theory (Brehm, 1972), the theory that when people feel that their freedom to engage in a particular behaviour is threatened, a reactive motivational state promotes them to re-establish their freedom by engaging in that behaviour.

While all models account for both warning and personal variables, Rogers et al. (2000) have not incorporated the utility judgement into their model, but instead focus on organising the literature. Wogalter et al. (1999) do acknowledge the cost-benefit analysis proposed by decision making theories, but do not explicitly integrate this into their model as Edworthy (1998) has done. As the personal and situational aspects of compliance are seen to be more influential than design features of a warning, placing the role of warnings within such a framework may be a more realistic approach. Indeed Kalsher and Williams (2006) provided a more specific model of how and when a warning fails to produce compliant behaviour than the C-HIP by considering how affective states and contextual variables interact.

No model is sufficient in explaining the relative weightings of potential factors due to the complexity of the process and difficulty in comparison across studies. Edworthy(1998) however provides the 'bare bones of the models' (p. 4) to be 'fleshed out' with systematic research. Kalsher and Williams (2006) also aim to identify and to stimulate further research. Therefore the models provide a useful platform on which to consider influencing factors.

Demographic factors

Individual differences have also been found for demographic variables which affect the warning process, for example age, gender and culture. The effects age has on various stages of the warring process, is suggested to be partly explained by cognitive aging and the effects demonstrated for memory, vision and hearing etc. as many of these abilities decline in old age. Easterby and Hakiel (1981) found people over 55 to have decreased warning comprehension. Bruyas (1997) showed that older individuals found it more difficult to comprehend symbols (due to decreased memory for the meanings of the symbols). Similar results have been found by a number of researchers (e.g. Lesch, 2004). Although these finding suggest that older adults may be unintentionally lower in compliance as they may not have noticed or understood the warning, there is evidence that older adults are more compliant by nature (Desaulniers, 1991) and that older people have higher hazard perceptions for warnings than younger people (Leonard et al., 1989).

There is mixed evidence for gender as a factor in the warning process. Godfrey et al (1983) and Laughery and Brelsford (1991) found that women were more prone to notice warnings signs than men. La rue and Cohen (1987) found women are likely to read and comprehend warnings. Similarly Mehlenbacher, Wogalter and Laughery (2002) found that more men reported having read their vehicles owner's manual than women. However, Easterby and

Hakiel (1981) found that men had better warning comprehension, the lowest levels arising from women who did not work. Goldhaber and deTurck (1988) found that males were more likely to notice no diving signs in a swimming pool. Greenfield and Kaskutas, (1993) and Kaskutas and Greenfield (1991) found that men were more likely to notice alcohol warnings on the packaging of their drinks, the results of the conflicting studies may be explained by differences in exposure, hazard perceptions and familiarity with warnings as formerly discussed. Indeed, Leonard et al. (1989) found that females hold higher hazard perceptions of warnings than men. This finding is in line with risk perception literature, which has consistently found that women judge risks as higher than men (e.g. Brody, 1984; DeJoy, 1992; Finucane, Alhakami, Slovic, & Johnson, 2000; Flynn, Slovic, & Mertz, 1994).

There are also age and gender differences in factors identified as affecting the warning process described previously. For example, younger people may be more susceptible to optimistic bias (DeJoy, 1992). Smith-Jackson (2004) found females had lower self-efficacy and a higher external locus of control. Such findings suggest young men are less likely to comply than any other demographic group.

The effects demographic variables have on the warning process is likely to be driven by other biological and social mechanisms, for example, age can be seen as an index for cognitive and perceptual changes. Researchers have argued it is important to examine the mechanisms that drive the observed differences in warning perception and compliance (Rogers et al., 2000). For example, age differences in the noticing of warnings, as previously discussed may be driven by differences in vision and hearing associated with age, not age itself. As age and gender can be markers for other social, biological and cognitive differences, it is possible that part of their effect on warning variables is driven by risk-taking propensity. The two fields of research have yielded similar patterns of age and gender effects, which will be examined later in this chapter.

In summary, there are a large number of factors influencing warning compliance, many of these factors concern the design and implementation of the warning itself. It is important to recognise the role that the individual characteristics of the receiver play in hazard perceptions and compliance rates. As acknowledged by the models formerly presented, no matter how well designed and placed a warning is, it will be interpreted by the individual as a function of environmental, biological and cognitive factors unique to them. Indeed, "there is little data to suggest that even the best designed warning will override the beliefs and expectations that the individual brings to the situation" (DeJoy, 1991, p. 1044). This may lead to certain individuals engaging in behaviour that is both dangerous to themselves and others by ignoring warnings. It is possible that an individual's risk-taking propensity may affect the way they perceive and interact with warnings. Before examining this potential relationship, various approaches to assessing risk-taking propensity will be discussed.

1.2 An Introduction to Risk-taking Propensity Research

Risk-taking is a complex area of human behaviour and although there is much disagreement over how it should be conceived and researched, risk is consistently thought of as an occurrence involving uncertain consequences with the potential for loss of some kind (Yates & Stone, 1992). There are numerous and diverse approaches to risk within the vast literature, however most approaches to risk-taking fall under two main strands. One strand considers risk as the variance of possible outcomes of decisions (often financial) and risk-taking propensity as a preference for options with a higher payoff variance (Schonberg, Fox, & Poldrack, 2011). Llewellyn (2008) defined this strand as the neuropsychological paradigm as it emphasises the neurological correlates of decision making. The other strand, the psychometric paradigm (Llewellyn) considers a broader conceptualisation, with risk-taking propensity defined as the willingness to engage in behaviour which has the potential to result in harm to oneself and/or others, typically from a clinical standpoint (Schonberg et al., 2011) This strand emphasises individual differences as well as associations between risky behaviours and stable dispositional influences (Llewellyn). Due to the complex nature of risk-taking behaviour itself and the wealth of conflicting and often disjointed literature, the examination of all proposed theories and approaches to risk-taking propensity is beyond the scope of this thesis. Instead the two broad strands are presented with a discussion of some prominent approaches from each area with examples of methodology used to examine differences in risk-taking propensity in each.

Decision Making approach/ Neuropsychological paradigm

The first approach decomposes risk-taking propensity into individual decisions. Classical decision theories (Savage, 1954; von Neuman & Morgenstern, 1947) propose that there are four basic elements that are considered when people make decisions. First, there are a number of alternative potential courses of action available to the decision-maker. Second, there are a number of events or states of the world. Third, each combination of action and events has a potential outcome and fourth, each outcome has a probability of occurrence. Expected utility models of risky choice hold that the decision-maker attempts to maximise the expected value or 'utility' of the outcome of their decision by considering the four elements. While there are alternative models of risky choice, for example Risk-Return models derived from economic research (e.g. Markowitz, 1952), Expected Utility theory has been accepted as the dominant model of rational choice (see Weber, 2010 for a historical overview of expected utility and risk-return models). Under this approach individual differences in risk-taking propensity are defined as a preference for risk or 'risk attitude'. The Subjective Expected Utility theory (SEU; e.g. Edwards, 1954) explains that individuals with a risk-averse attitude have a concave utility function, where the expected utility of a decision is smaller than its expected value, whereas individuals with a risk-seeking attitude have a convex utility function, where the expected utility of a decision is larger than its expected value. See Figure 1.5 for an illustration.

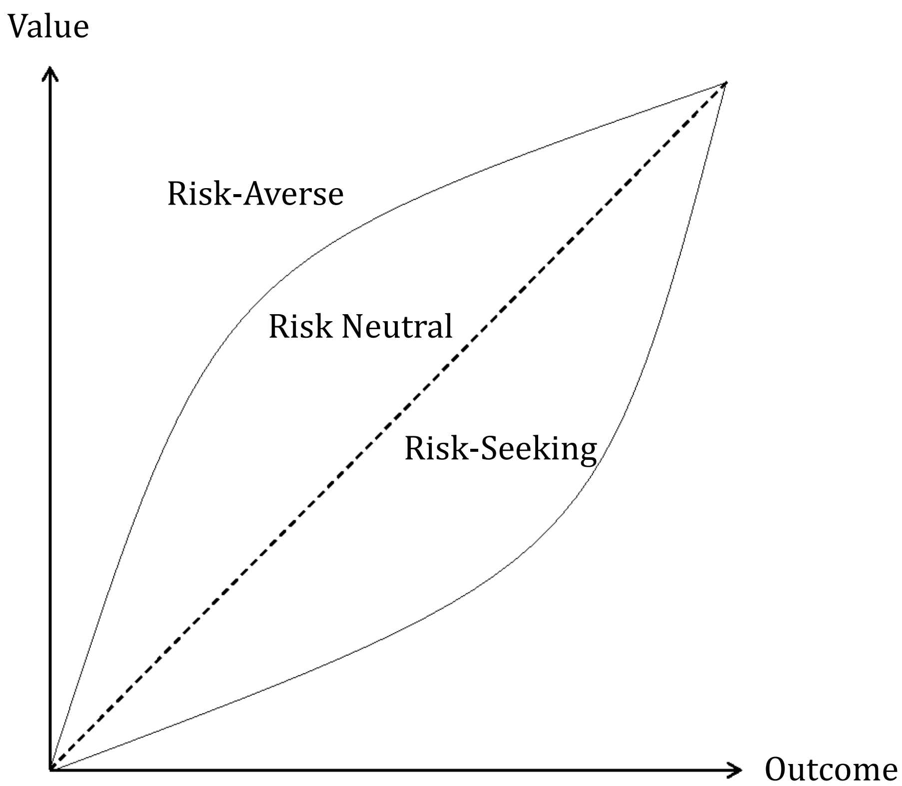


Figure 1.5 Example of concave and convex utility functions (SEU)

Prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981) extend the SEU model and describe an s-shaped utility function, and sees the function of relative costs and benefits as changing from a neutral reference point. Risk-seeking attitude occurs when a small but certain cost is considered less attractive than an uncertain larger cost. Risk-aversion occurs when a small but certain benefit is considered more attractive than a larger but uncertain benefit. Prospect theory assumes that there is an asymmetry in the steepness of the slope of the s-shaped utility function (see Figure 1.6 for an illustration) with a steeper function for costs or losses. Therefore people are risk-seeking in the domain of losses but risk averse in the domain of gains. People tend to take large gambles to avoid a small but certain loss, whereas people often prefer to accept a small gain, rather than gamble for a larger gain. It is suggested that the negative affect related to loss has more salience than positive affect related to gains, meaning that people will take bigger risks to avoid losses. This is related to the way a decision is framed, which can influence risk attitudes (for example, if a message is presented emphasising losses people are more likely to be risk-seeking than when the message emphasises gains (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). For a review of framing effects see Rothman and Salovey (1997).

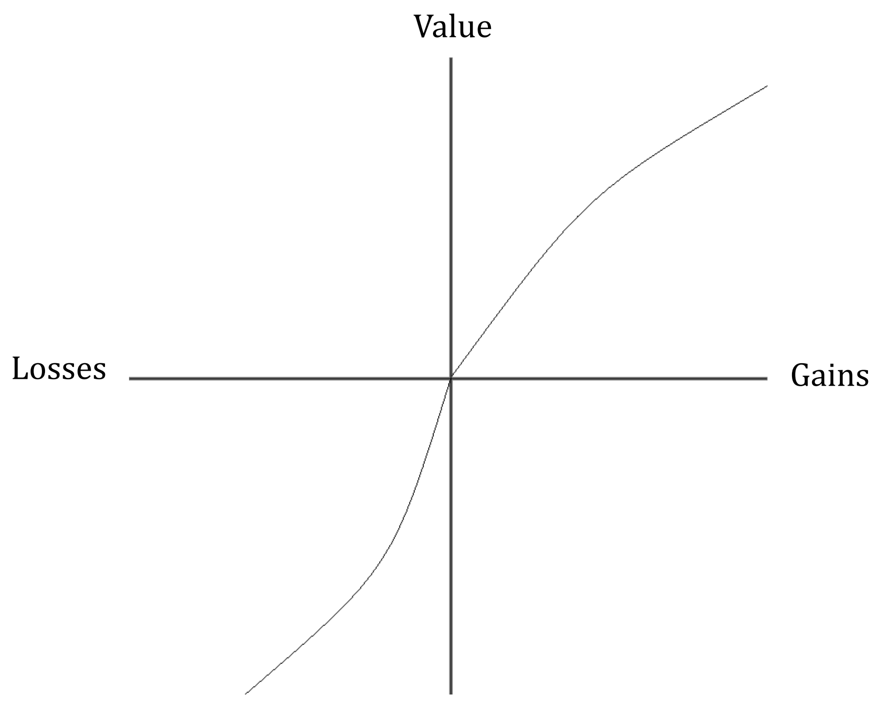


Figure 1.6 Prospect Theory utility function (Kahneman & Tversky, 1979)

Neither expected utility nor risk-return approaches adequately explain decisions made in laboratory and real-world settings (Weber, 2010). This is not surprising given that the decision-maker is limited by cognitive capacities and situations do not often provide enough information to make an accurate calculation. For example, exact probabilities of outcomes are seldom known, and therefore must be based on expectations or perceptions. Risky decision making often occurs under a 'constant barrage of information' (Williams, 2007, p. 45) where it is difficult, inappropriate and often impossible to undertake a rational calculation of all potential cost and benefits associated with a behaviour. Prospect theory also explains how deviations from basic utility judgements are accounted for by heuristics (Kahneman et al., 1982; Tversky & Kahneman, 1974). Humans rely on heuristics or 'rules of thumb' to reduce cognitive load and allow faster and more effective decision making. However, the misapplication of heuristics can lead to biases, which bring about irrational and ineffective decision-making particularly in high risk situations (Williams, 2007). Some common heuristics identified which can bias decision making are representativeness, availability, anchoring & adjustment and simulation (Kahneman et al., 1982). The representativeness heuristic refers to the fact that when evaluating probabilities, people typically consider the extent to which an event or object etc. is representative of or similar to another instance and tend to neglect base rate probabilities. The availability heuristic refers to notion the that the likelihood of an event is evaluated on the basis of how available associations or examples of that event are, that is how quickly and easily examples come to mind. If associations of an event are readily available, the likelihood of an event occurring may be overestimated. The anchoring and adjustment heuristic refers to the finding that when making judgements under uncertainty people tend to start with a certain reference point (anchor) and then adjust it on the basis of new information to reach a final conclusion. The initial reference point can skew judgement, resulting in the conclusion being too close to the reference point. The simulation heuristic refers to the extent to which the outcome of a scenario is mentally simulated, that is the ease with which it can be imagined. These heuristics are potentially relevant to risk-taking propensity as they help explain why high risk-takers engage in risky behaviours. Another heuristic that can bias decisions is the affect heuristic (Finucane et al., 2000; Slovic, Finucane, Peters, & MacGregor, 2002) which highlights the role of emotions and affective judgements in decision making. Representations of objects and events etc. are thought to be associated with different emotions and that consciously or unconsciously, decision makers draw on these emotions as cues. There is evidence that emotions have a different and often larger influence on risk-taking behaviour than do cognitive evaluations, see Loewenstein, Weber, Hsee and Welch (2001) for a review. Similarly, Regret Theory (Bell, 1982; Loomes & Sugden, 1982) holds that anticipated emotions (e.g. regret and rejoicing) influence the utility judgement and individual differences in decisions making can be explained by sensitivity to regret. The potential interplay between heuristics, affect and risk is investigated further in Chapter Four.

Traditionally, individual differences in risk attitude are often assessed by presenting participants with options, some representing a risky choice and some representing a 'sure thing' or safe choice (see Wärneryd, 1996 for a review). For example, Misha and Laumiere (2011) implemented a task where participants were asked to choose between receiving a guaranteed \$3 or a 10% chance of receiving \$30, with the latter choice indicating a preference for risk or a risk-seeking attitude, whereas preference for the safer options is thought to represent a risk-averse attitude. Similar methodology is frequently implemented in experimental situations and has succeeded in identifying specific brain regions (in particular the midbrain dopamine system) implicated in risky choice with a degree of consistency (see Llewellyn, 2008; Schonberg et al., 2011, for reviews). The example concerns an unambiguous decision task, however in real-world situations the values and probabilities are seldom known; therefore, ambiguous task have been developed where the outcome probabilities are not known (Zamarian, Sinz, Bonatti, Gamboz, & Delazer, 2008).

Although popular, risky choice paradigms are subject to serious limitations. Risky choice paradigms are devised to measure 'state-dependant' risk-taking propensity (Mishra &

Lalumière, 2011, p. 2), that is differences in risk-taking propensity after an experimental manipulation. However, there is evidence that 'stable dispositional traits underlie risky decision making' (Lauriola, Levin, & Hart, 2007, p. 146) and such measures may not effectively capture inter-individual variation. Risky choice tasks are rarely successful at predicting individual differences in risk-taking behaviour in naturalistic situations (Wallsten, Pleskac, & Lejuez, 2005). This may be due to the fact that risky choice tasks are static in nature whereas real-world risk (such as substance abuse or risky driving behaviour) is dynamic in that it is incremental and allows feedback which influences further decisions (Weber, 2010). 'One-shot' decisions like those represented risky choice tasks may not capture the complex nature of risk-taking propensity (Mishra & Lalumière, 2011).

Two behavioural tasks which are more complex and have predicted naturalistic risk behaviour with more success (Schonberg et al., 2011) are the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) and the Balloon Analogue Risk Task (BART; Lejuez et al., 2002). The IGT is thought of as the most popular behavioural task in this area (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005) as it allows participants the opportunity to win money by selecting cards from four decks, two of which are risky choices and two of which are safe choices. Participants learn the distributions of risky and safe decks through trial and error. The task has had much use within clinical groups associated with naturalistic risk-taking (e.g. pathological gamblers, and alcohol and substance users). However, as participants need to learn the nature of the task, it is not clear whether differences in IGT relate to individual differences in risk-taking propensity, learning or sensitivity to gains/losses (see Buelow & Suhr, 2009 for a critical review of the IGT). The BART, on the other hand, is a computer-based task that presents participants with a series of balloons on screen. Participants are required to 'pump up' the balloons one at a time by clicking the mouse. The participant earns a reward for each pump (typically money or points to be exchanged for prizes) and these rewards are then stored in a temporary bank until the participant decides to transfer the accumulated rewards into a more permanent bank. Each balloon has a different bursting point and if the participant allows the balloon to burst, the rewards for that balloon is lost. The BART is considered advantageous over the IGT as instead of offering a high risk/low risk choice, the participant's risky behaviour is incrementally rewarded until it peaks at an unknown point after which continuation of the behaviour is detrimental. In this respect the task is representative of real-life risky situations. The BART has been found to be related to an assortment of risk behaviours in adults and adolescents, whereas the IGT shows little correlation with the established risk measures and with risky behaviour aside from its associations with addictive clinical populations (Aklin et al., 2005; Lejuez et al., 2002; Petry, 2001).

Another issue which may affect many of the behavioural measures of risk-taking propensity presented is that most concentrate on financial gains and losses. There is evidence that individuals tend to attribute different weightings to risks and benefits within different domains of risk and someone who is a high financial risk-taker may not necessarily take risks in another domain (e.g. Hanoch, Johnson, & Wilke, 2006; MacCrimmon & Wehrung, 1986; MacCrimmon & Wehrung, 1990; Schoemaker, 1990; Weber, Blais, & Betz, 2002). In order to explore this, Weber et al. (2002) created the Domain-Specific Risk-Taking scale (DOSPERT). The scale examines risk attitudes across five domains: Ethical, Financial, Social, Health/Safety, and Recreational and measures self-reported likelihood of engaging in risk behaviour as well as risk perceptions and perceived benefits for the behaviours in each domain. The domains specific nature of risk-taking propensity will be examined further in Chapter Three.

Although there may be some issue with some decision-making measures in predicting individual differences in naturalistic risk-taking, it is rarely disputed that when considering whether or not to engage in a risk, individuals trade-off the subjective cost and benefits or risks and rewards. For example Weber, Blais and Betz (2002) found that both risk perceptions and expected benefits predicted participants' self-reported likelihood in engaging in various risky behaviours.

Psychometric paradigm

The psychometric approach to risk research places more importance on individual differences which influence risk-taking propensity. This approach aims to predict risk-taking behaviour from attitude scales, personality constructs and motivational traits with the view of constructing a 'personality profile' (Llewellyn, 2008). Such a profile (if achievable) may prove useful in determining how an individual might process warnings and engage with hazards.

The psychometric approach is not necessity at odds with the more decision-focused approaches. It is often assumed that dispositional differences may affect the perceptions of utility (e.g Demaree, DeDonno, Burns, & Everhart, 2008). Risky behaviour is also seen as manifestations of underlying biological and neurological processes. Much attention has focused on personality types which are thought to represent arousal sensitivity and inhibitory control as well as sensitivity to gains and losses.

Reinforcement Sensitivity Theory (Gray, 1970; 1982) holds that individual differences in the decision to approach or avoid a risky situation are accounted for by a biological sensitivity to reward and punishment. According to Reinforcement Sensitivity Theory the motivations to approach or avoid risks are controlled by separate neural systems. Approach motivation is proposed to be regulated by the Behavioural Activation System (BAS) and avoidance motivation by the Behavioural Inhibition System (BIS). The BAS is associated with sensitivity to reward (both conditioned and unconditioned) and has a biological basis though dopaminergic pathways, particularly between the ventral tegmental area and the nucleus accumbens (both of which project on the prefrontal cortex). The BIS on the other hand is associated with sensitivity to punishment or non-reward and has a basis in the right anterior cingulate cortex. Revisions to the theory (Gray & McNaughton, 2000) have led to the conceptualisation of BIS as a system that motivates avoidance by increasing attention to potential dangers. Thus an individual with high BIS activation may 'over attend to the warning signs of a behaviour' (O'Connor, Stewart, & Watt, 2009, p. 515) leading to anxiety and withdrawal behaviour where as high BAS activation increases motivation towards goals, positive emotions and sensitivity to reward. The distinct brain structures associated with the BIS and BAS suggest that these are independent systems. Carver and White (1994) developed scales to measure manifestations of the BIS and BAS systems. Neurological correlates of these scales have been found to correspond with brain structures as outlined above. For example, Amodio Master, Yee and Taylor (2008) found high levels of BIS were associated with anterior cingulate cortex activity whereas high BAS was associated with prefrontal cortex activity. Similarly, Sutton and Davidson (1997) found a correlation between midfrontal asymmetry (using Electroencephalography) and BIS/BAS scores which was interpreted as consistent with the conception of BIS as an avoidance system and BAS as an approach system. The scales have also been related to risk-taking behaviour and risk perception, Braddock et al. (in press) found both scales to relate differentially to alcohol, tobacco and illegal drug use as well as risky sex and safety behaviours such as seat belt use. Franken and Muris (2006) and O'Connor et al. (2009) found similar results. Also Leikas, Lindeman, Roininen, and Lähteenmäki, (2007) found that individuals with high BIS scores perceived food related risks as greater than those with low scores on this scale.

While the BIS/BAS scales can be conceived as personality traits themselves, the BIS and BAS systems are considered to underlie secondary personality traits, for example extraversion and neuroticism (Corr, 2008). Risk-taking propensity has been also associated with such traits, for example 'broad' traits like the five-factor model (Lauriola & Levin, 2001; Nicholson, Fenton-O'Creevy, Soane, & Willman, 2002; Nicholson, Soane, Fenton-O'Creevy, & Willman, 2005). Although there is some success in predicting risk behaviours from such broad personalities, research has historically focused on predicting risk-taking with 'narrow' or lower level traits (Llewellyn, 2008). The most widely used and highly validated personality trait in this area is Sensation Seeking (Zuckerman, 1994).

Sensation seeking is a personality construct defined as "The seeking of varied, novel, complex and intense sensations and experiences, and the willingness to take physical, social, legal and financial risks for the sake of such experiences" (Zuckerman, 1994, p. 27). This definition suggests that risk-taking behaviour is not the motivation for most sensation seekers but is a means of obtaining the stimulating experience which they seek. Sensation seeking has been consistently and frequently related to engagement in risk behaviour (see Roberti, 2004 for a review). High sensation seekers have been found to engage in health related risky behaviours, for example excessive alcohol consumption, substance abuse, smoking and risky sexual behaviour (e.g. Aklin et al., 2005; Cohen & Fromme, 2002; Lejuez et al., 2003a; Lejuez, Aklin, Zvolensky, & Pedulla, 2003b; Lejuez et al., 2002; Zuckerman, Ball, & Black, 1990). High sensation seekers are also more likely to engage in risky lifestyle choices including risky leisure activities like extreme sports (Wagner & Houlihan, 1994), risky travel (Lepp & Gibson, 2008) and are over represented in risky occupations (Zaleski, 1984). Sensation seeking has been associated with gambling (Lejuez et al., 2003b) and criminal or delinquent behaviours (Aklin et al., 2005). High sensation seeking is also related to various risky driving behaviours (see Jonah, 1997 for a review) including speeding (Burns & Wilde, 1995; Jonah, Thiessen, & Au-Yeung, 2001; Zuckerman & Neeb, 1980), traffic violations (Burns & Wilde, 1995), tailgating (Heino, van der Molen, & Wilde, 1996a, 1996b; Rosenbloom & Wolf, 2002), drink driving (Arnett, 1990; Jonah et al., 2001) and attempting to 'beat the train' at railway crossings (Witte & Donohue, 2000).

Given the relationship between sensation seeking and risky behaviour it seems likely that high sensation seekers may have lower evaluations and perceptions of risk and there is some evidence for this. Horvath and Zuckerman (1993) asked respondents to rate the chance of negative outcome from engaging in risky activities. They found that high sensation seeking was related to the tendency to make low risk appraisals of a range risky situations and behaviours including crime, minor violations and sports injury. Financial risk perception was not significantly related to sensation seeking, suggesting the relationship between sensation seeking and risk appraisal is not consistent across all domains of risk, consistent with the view that risk-taking itself is domain specific (e.g. Weber et al., 2002).

It appears that high sensation seekers perceive the world as a less dangerous place and that they perceive their actions are less likely to lead to negative consequences than those low on this construct. Franken et al. (1992), found high sensation seeking to relate to low perception of the danger of various behaviours (measured by a danger assessment questionnaire asking participants to rate the dangerousness of behaviours on a five point scale) as well as willingness to take risks. Jonah et al. (2001) found that high sensation seekers believed the risk of being caught drink driving by police is significantly lower than low sensation seekers. Rosenbloom (2003) found high scores on the Hebrew version of the Sensation Seeking Scale were found to be related with scores on the Inventory of Risk Evaluation, which asked participants to rate the dangerousness of situations involving both involuntary and voluntary risks. Witte and Donohue (2000) found that high sensation seekers were more likely to ignore signals at a grade crossing and perceived the likelihood and severity of an accident resulting from this behaviour to be lower than low sensation seekers. Heino et al. (1996a) asked participants to drive a test car on a stretch of motorway and to follow a car in front. High sensation seekers preferred a shorter following distance compared with low sensation seekers. When the following distance was prescribed by the researcher, high sensation seekers exhibited lower physiological arousal and gave lower verbal risk ratings than low sensation seekers during short prescribed distances suggesting that they perceived less risk from their behaviour than high sensation seekers. Some studies however have revealed no difference between high and low sensation seekers and risk perception. Zuckerman, et al. (1990) found that although more teenagers high in sensation seeking smoke, there was no significant difference in the perception of the risks involved. Lepp and Gibson, (2008) studied American participants' preferred travel destinations and their perception of risk associated with those destinations. They found no significant difference in risk perception between high and low sensation seekers, with the exception of Australasia/Oceania where high sensation seekers did perceive this destination to be less risky than low sensation seekers. It is possible that these results may be explained by the extent to which the risks are widely known. The risks of smoking are highly publicised and the knowledge of the dangers associated are well known to most teenagers. Similarly, Lepp & Gibson (2008) suggest that the American media frequently reports of the dangers in many of the locations in their study (e.g. the Middle East) and therefore the risks well known to the public, whereas danger in Australasia are less frequently reported in the USA.

It would be tempting to conclude that sensation seekers' lower risk perception leads them to engage in risky behaviours; however this appears not to be the case. Rosenbloom (2003) suggested that the more risk a sensation seeker evaluates from a behaviour; the more likely they are to engage in it. However, as previously mentioned the definition of sensation seeking suggests that the risk is not the goal of the sensation seeker and there is evidence that sensation seekers take steps to minimise the level of risk involved with their pursuit of stimulation (Zuckerman, 1979; 1991; 1994). Horvath and Zuckerman (1993) investigated whether high sensation seekers' behavioural expressions are the result of the fact they evaluate the risks associated various behaviours in which they engage in as less severe compared to low sensation seekers, or whether they tolerate the risks involved, as a means of obtaining the rewarding sensations which they seek. The results their of structural equation modelling suggest that although sensation seekers do perceive risks to be lower, this appears to be a *consequence* of their behaviour and not the cause. Consistent with the effects of familiarity observed in warning research, as sensation seekers engage in risky behaviour and experience rewarding rather than adverse consequences, the level of risk they perceive from that behaviour decreases. However there is evidence that high sensation seekers hold lower evaluations of novel risks compared with low sensation seekers. High sensation seekers appraise situations of which they have no previous experience as less risky than do low sensation seekers and are more likely to engage in such behaviours (Zuckerman, 1979), suggesting that their lowered risk perception may lead them to engage in the risky behaviour.

Another explanation for sensation seekers' risky behaviour is that they may be prone to optimistic bias. Rosenbloom (2003) proposed that sensation seekers' engagement in risky behaviour may be a result of an overestimation of their skills and ability to control risks.

Supporting research by Witte and Donohue (2000) found that high sensation seekers' risky decision making (choosing to run a red light at a railway crossing) was driven partially by a distorted sense of their own ability to avoid negative consequences. This is consistent with the findings of Solomon, Ginzburg, Neria, and Ohry (1995), who investigated the effects of sensation seeking tendency on the experience of Post-Traumatic Stress Disorder (PTSD) in prisoners of war. They found high sensation seekers held captive were less likely to develop PTSD than low sensation seekers as they perceived that they had more control of the situation and found the experience less stressful. Witte and Donohue (2000) also found that high sensation seekers were more likely to ignore signals at a grade crossing mainly due to their boredom susceptibility. High sensation seekers experienced greater frustration when waiting at a level crossing and so were more willing to endanger themselves in order to avoid the negative affect. Therefore, it appears that sensation seekers' risky behaviour may be driven by an overestimation of the rewards involved with the behaviour on one hand and an underestimation of the risks on the other, which in part may be due to overconfidence in their own ability.

Zuckerman (2006) explained that when considering a novel or potentially risky situation, negative arousal (anxiety or avoidance motivation) increases in a linear fashion as a function of perceived risk. Positive arousal (approach motivation) on the other hand increases until a critical point (the optimum level of arousal) after which it declines, when the risk becomes too high to tolerate, (the perceived risk outweighs the potential rewards). Zuckerman (1979) examined anticipatory affect in hypothetical situations and found that the rise in anticipated positive affect is steeper for high sensation seekers than for low sensation seekers. The optimum level of arousal is higher for high sensation seekers than for lows and the decline in positive affect is greater for low sensation seekers than highs. Mellstrom, Cicala and Zuckerman (1976) observed similar results for behaviour in naturalistic settings. Zuckerman (2006) proposed that sensation seekers' propensity to engage in novel risky behaviour can be explained by a high approach gradient (an over-attraction to reward, leading to higher anticipated positive affect) and a low avoidance gradient (an under-sensitivity to punishment which leads to lower anticipated negative affect). From this conception, it is easy to draw parallels between sensation seeking and the BIS and BAS systems.

Zuckerman (1994) argued that sensation seeking as a trait has a genetic and biological basis (see Roberti, 2004 for a review). Novelty (sensation) seeking has been related to a dopamine receptor gene (see Zuckerman, 2006). Zuckerman and Kuhlman (2000) also implicated the role of monoamine neurotransmitters, dopamine in particular, in risk-taking behaviour and associated personality traits like sensation seeking and impulsivity.

Similar biological processes and motivations have been suggested to underlie the trait of impulsivity (Cross, Copping, & Campbell, 2011). In fact sensation seeking and impulsivity are thought to be two components of a broader 'super-trait', impulsive sensation seeking (Zuckerman & Kuhlman, 2000, p. 1000). Impulsivity itself has been implicated in risk-taking behaviour and is also related to approach and avoidance mechanisms (Eysenck & Eysenck, 1985; Zuckerman & Kuhlman, 2000). Although there have been many distinctions of impulsivity in the literature (Cross et al., 2011), many highlight a tripartite distinction; a high approach motivation, a low avoidance motivation and/or problems with higher order cognitive processes, for example difficulty with effortful control. Impulsivity has been suggested to be related to risk-taking as people who act impulsively are more likely to take risk as they are not thinking about the consequences of their actions. Indeed Stanford, Greve, Boudreaux, Mathias and Brumbelow (1996) found that impulsivity was related to self-reported engagement in risky behaviours involving aggression, drug use, drink driving and seat belt use.

As previously mentioned, the BIS and BAS systems are thought to underlie other personality traits, and both the BIS and BAS scales have been associated with similar risky behaviours as both sensation seeking and impulsivity (e.g. substance use, risky driving and sexual behaviour). Indeed, Braddock et al. (2009) found that impulsive sensation seeking (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993) mediated the relationship between BIS and BAS and risky behaviour. While this suggests that impulsivity and sensation seeking may be somewhat redundant in predicting risk-taking behaviour, there is evidence that the three scales predict different types of risk-taking in decision making paradigms. Demaree, DeDonno, Burns and Everhart (2008) gave participants two versions of a gambling slot task. In one version the participant could set the wager and the probability of a loss was fixed whereas in the other the wager was fixed and the participant could set the probability. They found that risk-taking in both games was related to low levels of BIS, sensation seeking was related to risk-taking in the version where the participant could set the probability only and impulsivity was not related to risk-taking in either task. Also cross-sectional and longitudinal research has found impulsive and sensation seeking traits develop at different rates during adolescence, supporting a dual systems model of risk-taking (Harden & Tucker-Drob, 2011; Steinberg, 2008). Therefore, it may be assumed that sensation seeking and impulsivity tap into different aspects of risk-taking propensity.

Other researchers have attempted to bridge the gap between the psychometric approach and decision-making risk tasks. For example, Peters and Slovic (2000) found individuals who were risk avoidant in a modified version of the IGT scored highly on the BIS scale. Also Suhr and Tsanadis (2007) and Franken and Mauris (2006) found that high BAS was related to risk seeking on the IGT. Franken and Mauris (2006) also failed to find a relationship between performance on the IGT and impulsivity. The BART on the other hand has been found to be significantly correlated with sensation seeking and impulsivity (Lejuez et al., 2002). However, Llewellyn (2008) suggests further research is needed to understand fully the interplay between dispositional risk-taking and risky decisions.

1.3 Risk-taking and Warnings

The previous two sections review the areas of warning and risk-taking propensity research and hint at the similarities between the fields. There is potential for the field of risk-taking propensity to inform models of the warning process. The following section will explicitly review demographic similarities between the two fields, and introduce the limited work which has considered the role of risk-taking propensity on the warning process.

Demographic Similarities

It is clear that there are effects of age and gender on risk-taking behaviour. Men are consistently found to engage in a wide range of risky behaviours more frequently than women, this includes dangerous driving (e.g. Rhodes & Pivik, 2011), drug use (e.g. Degenhardt et al., 2008) and engagement in risky/extreme sports (Harris, Jenkins, & Glaser, 2006). Zuckerman and Kuhlman (2000) found that gender differences in risk-taking behaviour were almost entirely mediated by impulsive sensation seeking personality.

Indeed, gender and age have been found to be the 'two most significant demographic factors' in sensation seeking scores (Zuckerman, 2006, p. 14). Males have been found to be higher in sensation seeking than women, across all subscales (excluding experience seeking) with the largest differences between males and females found for scores on the thrill and adventure subscale (Zuckerman, 1979; 1994; Zuckerman, Buchsbaum, & Murphy, 1980). Zuckerman and colleagues propose that differences in risk-taking propensity between males and females is driven by the biological and social differences underpinning sensation seeking and related constructs, particularly as sensation seeking in thought to involve gonadal hormones (Zuckerman, 1994). Risk perception literature has yielded comparable effects of gender, for example women have been found to hold higher risk appraisals than men across a range of domains (Finucane et al., 2000; Flynn et al., 1994). However, Finucane et al (2000) argue that biological differences do not fully explain why women see risks as riskier than men, and that socio-political factors play a role. As formerly mentioned, similar patterns have also been found within warning research, e.g. women hold higher hazard perceptions with regard to warnings (Leonard et al., 1989) and are more likely to comply with them (Glover & Wogalter, 1997).

It has also been found that older adults engage in less risky behaviour than younger adults (Arnett, 1992; Gardner & Steinberg, 2005). From childhood to adolescence sensation seeking scores rise with age (Russo et al., 1993), peak in late adolescence / early twenties and gradually decline as age increases (Ball, Farnhill, & Wangeman, 1984; Zuckerman, 1983; 1994). It is suggested that hazard perceptions and compliance may decrease during adolescence and then increase progressively with age in an inverse manner. For example, Goldhaber and deTurck (1988) found that high school student were less likely to look for and comply with warning signs than middle school students. Older adults perceive more risk from a range of hazards than do young adults (Lehto & Foley, 1991; Leonard et al., 1989).

The similarity between the patterns of demographic effects for risk perception, risk-taking propensity and warning perception suggests that risk-taking propensity may be an 'underlying mechanism' which drives the demographic differences in hazard perceptions and compliance with warnings (Rogers et al., 2000).

Risk-taking propensity and the warning process

Although many researchers hint at the potential relationship between risk-taking propensity and the warning process (e.g. Rogers et al., 2000; Smith-Jackson, 2004), little empirical investigation has been conducted. A handful of studies have been conducted and have yielded mixed results. For example, Samms and Johnson (2002) found high sensation seekers to differ in their hazard perceptions of some colours but not warning symbols. Risk-taking and related constructs have also been associated with actual compliance. Witte and Donohue (2000) found that high sensation seekers ignored signals at level crossings due to a combination of their susceptibility to boredom and overconfidence in their abilities. Weaver, Gerber, Hancock and Ganey (2003a) found high sensation seekers displayed lower levels of behavioural compliance to warnings with signal words of medium strength (e.g. 'notice'), however a follow up study (Weaver, Helmick, & Burke, 2003b) failed to replicated these effects. Purwell, Schlegel and Kejriwal (1986) also found that a range of risk attitudes and some risk-taking behaviours were related to compliant behaviour with various potentially hazardous appliances. There were serious methodological confounds present within the majority of studies in this area, discussed further in Chapter Two, which may limit the strength of this evidence. Therefore empirical investigation into the potential for risk-taking propensity to affect warning compliance (and precursors to compliance e.g. hazard perception) is needed to establish whether there is a genuine effect.

As suggested previously, age and gender may be markers for underlying biosocial factors which affect risk-taking propensity and hazard perception. Measures of risk-taking propensity, for example sensation seeking, may be more viable than age and gender in predicting perceptions as they may measure those underlying processes more accurately, for example not all young males are high risk-takers. If measures of risk-taking propensity can identify a tendency towards lower risk perceptions, then such measures may predict compliance with warnings. High risk-takers may not perceive hazards and their associated warnings in the same way as low risk-takers, be it because they overestimate the rewards of the behaviour, or because they underestimate the risks involved, or because they overestimate their ability to deal with the hazard. Decision making can be influenced by subtle differences in the way that risky situations are presented. Therefore it is possible that manipulating the way a warning message is presented may affect the way high risk-takers view a hazardous situation.

Warnings may be designed and tailored to such individuals so that they calibrate their perceptions appropriately, thus producing higher compliance rates among high risk-takers. High risk-takers are arguably most in need of appropriately calibrated warnings as by their nature they are exposed to more hazard due to their recreational and vocational habits. This thesis explores the relationship between measures of risk-taking propensity and responses to warnings, an area sparsely covered within the warning literature, with potential application to the prevention of hazardous behaviours.

1.4 Overview of Experimental Chapters and their Findings

The initial aim of the present work was to investigate the potential effect of risk-taking propensity on the warning process. The first step was to establish a link between risk-taking propensity and warning perceptions, that is hazard perception and intended compliance to warnings. Studying behavioural compliance in a laboratory setting is often difficult without endangering participants, so warning researchers have traditionally relied on perceptual measures, for example hazard perception ratings and intentions to comply (Wogalter & Dingus, 1999). Recently researchers have explored the possibility of virtual reality as a means of assessing compliant behaviour (Duarte, Rebelo, & Wogalter, 2010); however due to practical constraints the studies presented within this thesis adopt the former approach. For the purpose of the research presented in this thesis, hazard perception of warnings and intentions to comply with them are collectively defined as *warning perception.*

An exploratory approach was adopted in Study One; a large number of measures were implemented in an attempt to cover a range of conceptualisations of risk-taking propensity. The warning stimuli consisted of very basic visual warning symbols and non- verbal auditory warnings so that the effects of risk-taking propensity on perceptions of the basic iconic features of warnings could be explored. This study focused on the perceptions of the iconic features of simple warnings; however information about the nature of the hazard itself may have more influence over compliant behaviour. Also as risk-taking propensity has been found to be domain specific (Weber et al., 2002), and the measures implemented in study one were fairly general, it was predicted that domain-specific measures may produce larger effect sizes. Studies Two and Three tested this prediction by implementing the DOSPERT (DOmain SPecific Risk-Taking; Weber et al.) scale and measuring participants' perceptions of contextual warnings from different domains.

As Studies One, Two and Three established that risk-taking propensity does have an effect on warning perceptions; Study Four examined the potential theoretical underpinnings of this relationship. As previously mentioned, people are thought to make a trade-off between their perceptions of the costs and benefits of their decisions (e.g. Baron, 2000), and that people's judgements are facilitated by biases and heuristics (e.g. Williams, 2007). The simulation heuristic (Kahneman et al., 1982) refers to the extent to which potential consequences are imagined or mentally simulated, and this may be relevant to the warning process. If an individual imagines their non-compliant behaviour as resulting in a positive outcome, they may be less likely to comply with a warning, whereas if they simulate negative consequences then they are likely to comply. Finally Study Five examined whether the disparity in warning perception between high and low risk-takers could be reduced through warning design, specifically by manipulating the statement of consequences.

The chapters presented within this thesis offer a unique contribution to the literature, firstly by empirically establishing effects of risk-taking propensity on warning perception, secondly by replicating the effect using different experimental designs and measurements, and third, by providing some insight into the theoretical underpinnings of this relationship.

Chapter Two

Study One: Measures of Risk-Taking Propensity as Predictors of Warning Perception

2.1 Introduction

It has been suggested that risk-taking propensity is related to the warning process in various ways, as reviewed in Chapter One. A relatively limited number of studies have attempted to examine the impact of risk-taking propensity on the warning process and they have produced mixed results. As a clear relationship has not yet been established, the aim of the present study is to explore empirically the extent to which measures of risk-taking propensity are related to warning perception (both the hazard perception of warnings and expressed intentions to comply with them).

As discussed in Chapter One, risk-taking propensity has many representations within the literature, so it is difficult to establish a single encompassing definition of a 'high risk-taker'. A few studies have investigated the potential for risk-taking propensity to impact upon various stages of the warning process using measures of risk-taking propensity which mainly fall under the psychometric approach.

Lion and Meertens (2001), for example found that high risk-takers do not seek out as much risk information about potentially hazardous medicines as low risk-takers. Samms and Johnston (2002) investigated the relationship between sensation seeking and compliant intentions towards iconic aspects of warnings. They presented participants with samples of colours (independent of a warning) as well as simple monochrome warning symbols and asked participants how carefully the stimuli would make them behave if they were seen on a warning. Participants' responses to each colour and symbol were examined individually and it was found that high sensation seekers (defined by scores on the thrill & adventure seeking and experience seeking subscales) differed from low sensation seekers in their hazard perceptions of some colours but not to any of the warning symbols. High sensation seekers differed from low sensation seekers only in their hazard perceptions of the colours blue, magenta and green (the colours associated with medium levels of hazard). Also Witte and Donohue (2000) found that high sensation seekers were more likely to report that they would not comply with signals at a level crossing.

Studies which have explored risk-taking propensity in relation to behavioural compliance have yielded mixed results. Purswell, Schlegel and Kejriwal (1986) examined risk-taking propensity (using various measures) and compliance to warnings on hazardous household appliances. They found that high scores on a risk-taking attitude questionnaire were related to unsafe (non-compliant) behaviour with all appliances, also that some reported risky behaviour (e.g. not following pedestrian signs and seat belt usage) predicted unsafe behaviour towards some appliances. They also included sensation seeking as a measure and found that the experience seeking subscale did predict unsafe behaviour to some products but in the opposite direction than expected, so that high experience seeking predicted more compliant behaviour; however coefficients and effect sizes from analyses were not presented.

Weaver, Gerber, Hancock and Ganey (2003a) found an effect of sensation seeking on precautionary behaviour when handling potentially dangerous chemicals. Participants were presented with warnings imbedded in safety instructions which advised participants to use three different forms of protective equipment. There were three warning conditions, varying in terms of signal word ('warning', 'notice' and 'no signal word'). The number of those precautions participants implemented was observed. High sensation seekers displayed lower levels of compliance but these effects were only found in the 'notice' condition. The authors concluded that high sensation seekers need stronger warning signal words to produce compliance levels similar to low sensation seekers.

A follow up study (Weaver et al., 2003b), failed to replicate the effect using a wider range of protective equipment in a wood work task. This finding may be explained by the relatively low power of the design. The authors reported that data from only 54 participants across 8 conditions were used in the analysis, which would have resulted in very small sample sizes in each condition. There were similar issues of power (as well as other methodological concerns) present in the majority of the studies discussed. For example Weaver et al. (2003a) report 112 participants in total with three warning conditions which were then allocated to high and low sensation seeking groups. As well as having small numbers of participants in each condition, there may be issues in the way that the data were split. The researchers did not report the mean and range of sensation seeking scores for each group or how sensation seeking scores were split into high and low (presumably using median split). As sensation seeking was measured *after* the allocation of participants to conditions, it is possible that sensation seeking scores would not have been equal across groups, meaning that a participants with average medium sensation seeking scores could be allocated to the high sensation seeking group (in relation to the other participants scores in that condition). Whereas a participant with the same score in another condition might have been be allocated to the low sensation seeking group. Similar issues are present in the study by Samms and Johnson (2002). Participants were median split into high and low groups, resulting in the lack of power and validity issues outlined previously. Also, the sample used was small (n= 47) and unbalanced demographically; therefore it may not have been representative enough to capture a range of sensation seeking scores.

As the evidence in this area is limited and subject to the methodological issues outlined, the potential relationship between risk-taking and perception and compliance with warnings requires clarification. The aim of the present study is to address these methodological issues and provide more reliable evidence within this area of research. Here large numbers of participants were obtained, and potential demographical influences were approximately balanced (e.g. age and gender, as both have been related to hazard perception, compliance, risk perception and risk-taking as reviewed in Chapter One). A correlational design was implemented so that all participants were exposed to all warnings, increasing the power of the study.

The present study focused on the relationship between risk-taking propensity and warning perception of simple iconic warnings. The warning stimuli consisted of basic warning symbols, made up of three iconic features which were manipulated factorially to convey a range of hazard levels. Two types of warning stimuli were used; visual warning symbols and non-verbal auditory warnings in the form of alarms. The warnings did not include a referent, that is, they did not communicate any information about a particular hazard. This was to establish if risk-taking propensity affects the perception of the basic iconic features of a warning, for example the colour, shape and signal word. The factors were manipulated on the basis of previous research which allowed a predicted level of hazard to be calculated for each warning. Participants were asked to provide ratings of hazard perception, specifically the level hazard or risk they believed each warning was intended to portray, and intended compliance, the likelihood that they would comply with any information associated with the warning. Such methods have been widely used within warning literature when actual compliance is impractical to observe (Wogalter & Dingus, 1999).

The measures of risk-taking propensity implemented

Sensation seeking was implemented as the primary measure of risk-taking propensity as the construct has been used widely in the area of risk perception and risk behaviour (Llewellyn, 2008). The construct has been frequently related to engagement in risky behaviour and to low risk appraisal (e.g. Franken et al., 1992; Heino et al., 1996a, 1996b; Horvath & Zuckerman, 1993; Rosenbloom, 2003). Also, sensation seeking has been most frequently implemented in the few studies which have examined risk-taking propensity and warnings, (Purswell et al., 1986; Samms & Johnson, 2002; Weaver et al., 2003a; 2003b; Witte & Donohue, 2000). Although sensation seeking was the main focus of the present study, other measures which have been found to be related to various aspects of risk-taking propensity may also be relevant to the warning process. As discussed in Chapter One, impulsivity and behavioural inhibition/ activation have also been associated with risk-taking propensity and risky behaviour (e.g. Braddock et al., in press; Franken & Muris, 2006; O'Connor et al., 2009;

Stanford et al., 1996) and therefore may also be suitable measures of risk-taking propensity in the present study.

As discussed in the previous chapter there are many definitions of impulsivity (Cross et al., 2011) and several measures of the construct. Traditionally impulsivity was treated by Eysenck and Eysenck (1963) as a component of extraversion, although exploration revealed two distinct facets of impulsivity, one (Venturesomeness) loading on extraversion and one (Impulsiveness) on psychoticism as measured by the Eysenck Personality Questionnaire (EPQ). This lead to the creation of the IVE scale which measures Impulsiveness, Venturesomeness and Empathy (Eysenck & Eysenck, 1978). The Venturesomeness subscale includes items resembling those which measure sensation seeking, and has been found to be related to sensation seeking as well as risk perception and risk behaviour (Eysenck & Zuckerman, 1978; Moore & Rosenthal, 1993; Twigger-Ross & Breakwell, 1999). Therefore the IVE was implemented in the present study.

As discussed in Chapter One, the BIS/BAS scales have been demonstrated to tap into the avoidance and approach motivations as defined by Gray (1970; 1982). The BAS scale is made up of three subscales, BAS Reward (the enjoyment of reward), BAS drive (goal pursuit) and BAS fun seeking (the pursuit of novel and rewarding experiences). The distinction between the three subscales of BAS was not theoretically motivated but emerged from factor analysis of a set of items intended to measure a diverse range of BAS manifestations and cannot be reduced to a single factor (e.g. Voigt et al., 2009). All four components of the BIS/BAS may be theoretically relevant to the warning process, BAS fun seeking in particular, as it is comparable with sensation seeking in definition, in that both constructs are defined by a need for novelty.

As impulsivity, behavioural inhibition and behavioural activation have been demonstrated to relate to different styles of risk-taking than sensation seeking as discussed in Chapter One (Demaree et al., 2008), it may be possible they capture different aspects of risk-taking propensity and therefore were implemented in the present study.

The measures discussed so far are dispositional traits associated with risky behaviour and risk perceptions. More direct measures of these factors may also relate to warning perception. In order to investigate this, a risk perception scale and a risk behaviour scale were constructed specifically for the study. The risk perception scale presented participants with a list of risky behaviours and measured how risky or dangerous participants believed each one to be, whereas the risk behaviour scale required participants to report the extent to which they have engaged in the risky behaviours (within the last two years). Both scales featured the same items as is common within the literature (e.g. Rosenbloom, 2003; Weber et al., 2002). The items were selected from four general areas of risk-taking; sexual risk, dangerous driving, substance use, and alcohol-related risks. Although drinking alcohol may be classed as substance use there may be social and cognitive factors that separate it from drug abuse. For example, risky drinking may be more socially acceptable in the UK than drug use and even smoking. In some cases a person may drink dangerously but refrain from taking drugs for this reason. The general areas were chosen on the basis of previous research (e.g. Arnett, 1990), and are commonly implemented in risk-taking research. The four areas consist of activities which are fairly common amongst the general public.

The Risk-Taking Propensity (RTP) scale developed by Lion and Meetrens (2001) is a brief measure of risk-taking propensity that has previously been found to relate to the warning process. The scale asks the respondent to disclose how much they view themselves as a risk seeker or risk avoider. Despite being somewhat transparent and oversimplified, the scale boasts good reliability rates (Meertens & Lion, 2008). As mentioned, this scale has been found to relate to how much information people seek about potentially risky medication (Lion & Meertens). When encountering a risk, people often seek out more information about the risk and this varies as a function of hazard perception. As individuals with high risk-taking propensity sought out less information, it is possible that they perceived less hazard from the risky medication than those with low risk propensities as measured by this scale. Therefore the RTP scale may also correlate with warning perceptions.

The measures discussed so far fall under the psychometric approach to risk-taking propensity (Llewellyn, 2008). Although popular, self-reported measures are thought by some to lack validity in this area (Lejuez et al., 2002). They are subject to demand characteristics; participants may exaggerate or understate behaviours and attitudes to appear more socially desirable. In some cases inaccurate reports may arise from participants' inability to recall their own behaviours (Ladouceur et al., 2000). Lejuez et al. also argue that none of the personality constructs alone can accurately encompass the "multidimensional nature" of risk-taking behaviour (2002, p. 75). Also as personality constructs do not measure risk-taking directly it may be more appropriate to implement a behavioural risk task. In an attempt to overcome these limitations, behavioural instruments have now been implemented in this area, for example the Iowa Gambling Task (IGT; Bechara et al., 1994) and the Balloon Analogue Risk Task (BART; Lejuez et al., 2002). The BART was chosen as a behavioural measure of risk-taking propensity in the present study over the IGT due to its more realistic nature (as described in Chapter One) and association with the established risk measures and with actual risky behaviour (Aklin et al., 2005; Lejuez et al., 2002; Petry, 2001). As described in Chapter One, the BART task requires participants to pump up a series of virtual balloons (typically 30) presented one after each other on screen. For each pump of the balloon the participant receives a reward (a dollar or a point depending on the version of the task) which is stored in a temporary bank. To secure the accumulated reward the participant must stop inflating the balloon and move on to the next balloon. The maximum number of pumps a balloon takes to fully inflate is 128 but the bursting point of each balloon is randomised. If the participant over inflates the balloon, all points /money accumulated on that balloon are lost. Although the task is an analogy of risk-taking behaviour, by offering prize money there is a risk of not obtaining the money so the participants' behaviour may be considered more ecologically valid (C. Lejuez, personal communication, March 3, 2007). Participants in the present study obtained points for each pump and were told that the 15 highest scorers would receive cash prizes.

The measures discussed are by no means the only measures which are related to risk-taking propensity, there may potentially be many other risk related constructs that predict warning perception. However, it was considered that together the measures implemented cover a wide range of risk representations. The range of measures used tap into different aspects of risk-taking propensity (such as risk perception, risk-taking as a means of obtaining sensation and lack of inhibition/self-control), thus allowing exploration of the multifaceted nature of risk-taking propensity and its potential effect on warning perception. It can be argued that the measures implemented may not be considered *direct* measures of risk-taking propensity; however all have been found to be related to risk-taking behaviour and/or risk perception in various ways (e.g. Leikas et al., 2007; Lejuez et al., 2003b; Rosenbloom, 2003).

It was predicted that scores representing high risk-taking propensity on all measures should relate to lower hazard perception of, and lower intentions to comply with, the iconic warnings. Specifically, high sensation seeking scores should predict low hazard perception and compliance, as should high impulsiveness, venturesomeness, behavioural activation, risk behaviour, RTP and BART scores. High scores on the BIS and risk perception scales should predict low hazard perception and compliance. Previous research has shown demographic influences of risk-taking propensity and warning perception (discussed in Chapter One), therefore, it is expected that males should report lower warning perceptions than females and be higher in sensation seeking. Younger adults should also report lower warning perceptions, and be higher in sensation seeking than older adults.

2.2 Method

2.2.1 Participants

A total of 152 participants aged 18-61 (M age = 35.8 SD= 12.22) completed the study. As age and gender have been found to be predictors of risk-taking, sensation seeking and hazard perception, a large age range was sought. Gender was approximately balanced as previous research has found this to affect both risk propensity and warning perception (e.g. Glover & Wogalter, 1997; Laughery & Brelsford, 1991; Zuckerman, 2006). Table 2.1 displays the numbers of male and female participants in each age group. Paid participants were recruited via the University of Plymouth paid participant pool and from advertisements around the University campus. Undergraduate psychology students also participated for course credit. It was specified in the recruitment advertisement that all participants were required to have normal or corrected-to-normal vision and hearing due to the fact that they were to view coloured images and listen to auditory stimuli.

Table 2.1 Number of Male and Female Participants in Each Age Group

	18-29	30-39	40-49	50+	Total
Male	21	21	17	14	73
Female	22	22	20	15	79
Total	43	43	37	29	152

2.2.2 Materials

Warning Stimuli

The warning task was a computer-based task designed specifically for the study. During this task participants were presented with a total of 60 warnings (27 visual symbols, 27 auditory warnings and 3 practice stimuli for each modality) of varying hazard levels. Both the visual and the auditory warnings were designed to vary as a function of their hazard levels (arousal strength/urgency levels). This was achieved by factorially manipulating three iconic variables for each type of warning in accordance with previous research (e.g. Braun & Silver, 1995; Hellier, Edworthy, & Dennis, 1993). Three different hazard levels were selected for each variable, on the basis of previous research findings so that there was a high, medium and low example of hazard/urgency level for each variable. For the visual warnings, the manipulated variables were colour (Braun & Silver, 1995), shape (Riley et al., 1982) and signal word (Wogalter & Silver, 1990a). For the auditory warnings, the manipulated variables were pitch, speed and volume (Haas & Casali, 1995; Haas & Edworthy, 1996). The pitch levels of the pulses were defined by setting the fundamental frequency level (in Hertz). The speed was determined by varying the length of the inter-pulse intervals (in milliseconds), that is the duration between the offset of one pulse and the onset of the next. Volume was manipulated by setting the overall volume during creation of the stimuli. See Table 2.2 for the levels of iconic variables manipulated for each warning type. By designing the stimuli in this way, a relative predicted hazard level for each warning could be calculated, See Appendix 2A for the relative predicted hazard levels of each iconic variable combination for auditory and visual warnings.

Table 2.2 The Iconic Variables Manipulated for Auditory and Visual Warning Stimuli

Iconic Features Manipulated	Hazard level		
	High	Medium	Low
	Auditory Warnings		
Frequency (Hz)	800	500	200
Inter-Pulse Interval (Ms)	0	250	500
Volume (-dB)	0	5	10
	Visual Warnings		
Outline Shape	Triangle	Hexagon	Circle
Colour	Red	Black	Blue
Signal Word	Danger	Warning	Notice

The visual stimuli consisted of a signal word inside an outlined shape with a line thickness of 20 pixels (0.7cm). The symbols were designed using Adobe® Photoshop® and each warning was fit into a square of 255 x 255 pixels (8.04 x 8.04 cm) with a white background with a resolution of 28 pixel/cm. The font was Calibri in bold, size 38 and the signal words were printed in capitals. The three practice stimuli were created by varying the colour of existing stimuli for example the high hazard practice warning was a triangle with the signal word ‘danger’ in orange rather than red. See Appendix 2B for the full set of visual stimuli.

The auditory stimuli were designed using the program Cool Edit Pro version 2.0. The auditory stimuli were short samples of alarms consisting pluses of tones which had duration of 200ms. All warnings were created with a 44100 sample rate, mono channel and 32-bit resolution. All five frequency components were set to 100, the modulation frequency was set to 0 Hz and the flavour was set to sine. The pulses within the stimuli did not vary in terms of pitch and volume. The amplitude envelope for each pulse was set to the ADSR envelope setting. Each warning was approximately 2.4 seconds long. Participants were presented with the alarms through standard headphones so that multiple participants could be tested simultaneously and to avoid discrepancies arising from participants' proximity from the sound output. As the volume was set during creation of the stimuli, the output volume was measured for each session to ensure that individual differences in equipment were accounted for and the output volume was constant for all participants. This was done using a Pulsar © sound level meter, (model 33) and a 'test' alarm in a standardised manner.

Warning Perception

Hazard perception was measured using magnitude estimation with prescribed numbers between 1 and 100 with higher numbers representing high hazard levels. As the stimuli were presented in random order, a potential bias may arise for this method. The bias occurs when the participant gives a stimulus the maximum rating (100) and then upon seeing another stimulus which they believe to have a higher rating, they are forced to assign the same value even though they believe the latter to be higher (Engen, 1972). The three practice trials were implemented to attempt to overcome this bias by calibrating the participants' responses, this method has been used in similar studies (e.g. Hellier et al., 2000; Wogalter & Silver, 1990a).

Intended compliance was measured on a 7-point Likert-type scale with verbal anchors from 'definitely would comply' to 'definitely would not comply'. Practical considerations would not allow a measure of actual compliant behaviour in this study therefore behavioural intent was measured as the 'closest indication' of compliance questionnaire data can obtain and is commonly used in the warning literature (Wogalter & Dingus, 1999, p. 54). See Appendix 2C for a screenshot of the warning task which displays the wording of the measures of hazard perception and intention to comply with the warnings.

Risk-Taking Propensity

Sensation Seeking was measured by the Sensation Seeking Scale Form V (SSS-V; Zuckerman, 1994), which is a 40 item questionnaire with two choices to each item. The scale consists of four subscales: Thrill & Adventure seeking (TAS); Experience Seeking (ES); Boredom Susceptibility (BS); and Dis-Inhibition (DIS). Some of the items were slightly modified to ensure that language was not dated, for example the item “I would like to try surf board riding” was changed to “I have or would like to try surfing” for modernisation and to account for people who have already participated in the activity. See Appendix 2D for the full SSS-V.

Impulsiveness and Venturesomeness was measured using the IVE (Impulsiveness Venturesomeness Empathy) taken from the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1991). Empathy was excluded from analysis as is not theoretically relevant to risk-taking. Due to copyright protection it is not possible to provide a copy of the IVE in the appendices.

Behavioural Inhibition (BIS) and Behavioural Activation (BAS) was measured using the BIS/BAS scale (Carver & White, 1994) which consists of 24 items. BAS is made up of the three subscales Drive, Fun Seeking, and Reward Responsiveness. See Appendix 2E for the full scale BIS/BAS which also includes ‘filler questions’ not included in the analysis.

Both the risk perception scale and the risk behaviour scale consisted of the same 12 risky behaviours. Both scales provided participants with a seven point likert scale to make their responses. The risk perception scale can be found in Appendix 2F and the risk behaviour scale can be found in Appendix 2G.

Lion and Merteen's (2001) Risk-taking Propensity scale (RTP) can be found in Appendix 2H. The scale consists of seven statements and participants are asked to indicate the extent to which they agree with each statement on a nine-point Likert scale.

There are several versions of the Balloon Analogue Risk Task (BART; Lejuez et al., 2002), the version 'BART_Options_P' was chosen as it rewards participants with points for each 'pump' rather than dollars. The task was set up to give one point with every click of the mouse; the balloon sequence was set to variable rather than fixed (meaning the bursting point of each balloon was randomised). The option to have a counter present was set so that the participants could not see the amount of points they were acquiring until after the completion each trial. The participants with the 15 highest scores were rewarded with money. There were three prizes of £10 for the top three highest scorers and 12 prizes of £5 for participants in 4th to 15th place. Participants were informed whether they had won or not by email. The participants were presented with 30 trials and the number of average adjusted pumps was the dependant variable, that is, the average number of pumps a participant made across all 30 trials excluding the balloons that had exploded. See Appendix 2I for a screenshot of the task.

2.2.3 Procedure

Participants sat at individual desks with a computer screen, key board and mouse. Face down on the desks were the instructions for each of the tasks as well as a pen and a pair of headphones. As the study investigates individual differences, the order of the tasks were not balanced but fixed in the same order for each participant. This was to ensure that each participant completed the experiment in the same way and that any order effects would be constant across participants.

First, participants completed all risk-taking propensity questionnaires, with the exception of the IVE, presented on screen as a battery in which participants selected their response by clicking radio buttons. This method of presentation was used to avoid coding and data entering errors that may occur from manual entry. The IVE was presented on paper and could not be included in the computerised task due to copyright protection. Participants were asked to complete this questionnaire before completing the onscreen questionnaire battery. The order of presentation of the scales within the questionnaire battery was as follows: risk perception scale, the BIS/BAS, the SSS-V, the risk behaviour scale, and the RTP scale). The risk perception questionnaire was presented first to minimise potential order effects on the risk behaviour scale, as perceptions are less stable and may be more easily influenced than reporting frequency of actual behaviour. The instructions for this section of the study can be found in Appendix 2J.

Second, participants completed the warning task on the computer, the visual and auditory warnings were presented separately as two subtasks to reduce confusion and allow ease of judgement of the different types of stimuli. The warnings were presented one at a time, allowing the participant as much time as needed to make their judgement. Visual warnings were presented immediately on screen whereas participants were required to click on a button to play the auditory warning. Participants were provided with standard headphones and were allowed to listen to the auditory warning as many times as necessary. On screen to the right of each warning (or button in the case of auditory warnings) there the two items, the measure of hazard perception and the measure of intended compliance. Participants were given three practice trials of stimuli of varying predicted hazard level before the real experiment began to calibrate responses. The task did not allow participants to continue to the next warning until responses to both items were made in order to prevent missing data values. The instructions for this task are presented in Appendix 2K.

Third, participants completed the BART task on screen. Participants ‘pumped’ the balloon by clicking the left mouse button. As the BART includes sound effects, the participants were instructed to wear the headphones provided during this task (see Appendix 2L for the instructions for this task).

2.3 Results

2.3.1 Reliability of Measures

To ensure the stimuli and all psychometric variables were reliable, reliability analyses were carried out on the warning perception variables (hazard perception & intended compliance) and risk-taking propensity measures. The alpha score was >.90 for each warning perception measure which indicates very high reliability (Kline, 1999). The alpha scores for all risk-taking propensity measures ranged from .61 to .85 indicating moderate to high reliability. The mean score, standard deviation and Cronbach's alpha coefficient for the warning perception variables and all psychometric measures of risk-taking propensity are displayed in Appendix 2M.

2.3.2 Correlations between Warning Perception Variables

The warnings were designed by manipulating three variables based on previous research to achieve a varied set of warnings with a range of hazard levels. In order to establish if the participants perceived the range of warnings as intended, the predicted hazard level of each warning was correlated with the participants' hazard judgements.

For the auditory warnings, Pearson's correlation (two-tailed) revealed that participants' mean hazard perceptions and the predicted hazard levels warnings were significantly correlated, $r\ (27) = .92$, $p < .001$. For the visual warnings, participants' mean hazard perceptions that were observed and the predicted hazard levels were also significantly correlated, $r\ (27) = .82$, $p < .001$. As expected the participants perceived the warnings to vary in their relative hazard level and their ratings were consistent with the predicted hazard levels.

To determine whether participants' hazard perceptions were related to their intentions to comply, hazard perception and intended compliance were correlated for both types of warning. The correlation coefficients are presented in Table 2.3.

Table 2.3 Correlations between Hazard Perception and Intended Compliance

	Auditory Hazard Perception	Auditory Intended Compliance	Visual Hazard Perception
Auditory Hazard Perception	-	-	-
Auditory Intended Compliance	.65**	-	-
Visual Hazard Perception	.51**	.25*	-
Visual Intended Compliance	.27**	.53**	.62**

Note *p<.05 **p<.01

Hazard perception was highly correlated with intended compliance for both auditory and visual warnings. The participants' hazard perceptions for visual and auditory warnings were highly correlated, as were their intentions to comply with auditory and visual warnings. Auditory hazard perception was less robustly correlated with visual compliance as was visual hazard perception and auditory intended compliance.

As the hazard perception and intentions to comply with both types of warning were highly correlated and the combined hazard perception and intended compliance demonstrated good internal consistency the dependant variables for each type of warnings were combined to achieve two dependant variables; hazard perception and compliance to all warnings.

2.3.3 Correlations between Predictor Variables and Dependant Variables

The inter-relationships between potential predictor variables, of hazard perception and intended compliance were calculated using Pearson's correlation. The correlation coefficients are displayed in Appendix 2N. Consistent with previous research, risk perception correlated with sensation seeking, BART scores, RTP scores and BIS scores. Impulsiveness and venturesomeness were not significantly related to risk perception nether was any of the BAS scales. Also consistent with previous research, risk behaviour was correlated with sensation seeking, impulsivity, venturesomeness, BAS fun seeking, and RTP scores but not BART, BIS, BAS drive or BAS reward. All significant relationships were in the expected direction.

These potential predictor variables were then correlated with the dependant variables hazard perception and intended compliance in order to establish which variables are likely to be predictors of warning perception. The correlation coefficients for each predictor and dependant variable are displayed in Table 2.4.

Table 2.4 Correlation coefficients for potential predictors of hazard perception and intended compliance

Predictors	Hazard Perception	Intended Compliance
Sensation Seeking	-.14	-.17*
Thrill and Adventure Seeking	-.13	-.21*
Experience Seeking	-.07	-.12
Dis-inhibition	-.08	-.09
Boredom Susceptibility	-.10	-.06
Impulsiveness	-.07	-.20*
Venturesomeness	-.08	-.14
Behavioural Inhibition	.07	.22**
Bas Drive	-.05	.01
Bas Fun Seeking	-.09	-.07
Bas Reward	.11	.13
Risk-taking propensity	-.01	-.05
Risk Perception	.26**	.22**
Risk behaviour	-.07	-.15
Balloon Analogue Risk Task	-.25**	-.08

Note *p<.05 **p<.01

Hazard Perception

Participants' hazard perception ratings for all warning stimuli were significantly correlated with only two of the potential predictors. Hazard perception was positively related to scores on the risk perception scale and negatively related to scores on the BART.

Intended Compliance

Participants' intentions to comply with the warnings were significantly correlated with five of the potential predictors. Intended compliance was negatively related to impulsiveness, sensation seeking total and the thrill and adventure seeking scale. Intended compliance was positively related to both the risk perception scale and the behavioural inhibition scale.

2.3.4 Sensation Seeking and Intended Compliance

As sensation seeking was the main focus of the study a simple regression was carried out with sensation seeking as the sole predictor to confirm that sensation seeking independently predicts intended compliance. The same analysis was not carried out for hazard perception as it was not significantly correlated with sensation seeking. The analysis revealed that sensation seeking significantly and negatively predicted intentions to comply, $F(1,150) = 4.69$, $p<.05$, $\Delta R^2=.024$.

2.3.5 The Strongest Predictors of Warning Perception using Multiple Regression

To determine the best predictors of hazard perception and intended compliance, separate multiple regression analyses were carried out for each dependant variable, with the significantly correlated predictors. The standardised beta values for each predictor are displayed in Table 2.5 accompanied by the F value and adjusted r squared for each dependant variable.

Table 2.5 The regression coefficients for the predictors of warning perception

β	RP	BART	Imp	BIS	SS	F	df	ΔR^2
Hazard Perception	.21**	-.21*	-	-	-	8.90***	2,149	.10
Intended Compliance	.20*	-	-.21*	.16	.01	4.99**	4,147	.10

Note: * *p*<.05, ***p*<.01, *** *p*<.001

Hazard Perception

Hazard perception was correlated only with risk perception scores and BART scores. The analysis revealed that the model did significantly predict hazard perception, accounting for 10% of the variance in hazard perception. Inspection of the regression of the coefficients revealed that risk perception was the strongest predictor of hazard perception.

Intended Compliance

Intended compliance was correlated with risk perception, impulsiveness, behavioural inhibition and sensation seeking. The analysis revealed that the model did significantly predict intentions to comply, accounting for 10% of the variance in intended compliance. Inspection of the regression of the coefficients revealed that impulsiveness was the strongest predictor of intended compliance. Behavioural inhibition just missed significance as a predictor (*p*=.051), and sensation seeking was not a significant predictor of intended compliance.

2.3.6 Demographic variables

Previous research has found age and gender to affect risk perceptions, sensation seeking and warning perception (discussed in Chapter One). To examine the interplay between demographic variables, risk-taking and warning perception, a MANOVA was performed with age group and gender as independent variables and risk perception, sensation seeking, hazard perception and intended compliance as dependant variables. The means and standard deviations for each variable are displayed in Table 2.6.

Table 2.6 Means (and Standard Deviations) for Age and Gender

Measure	Gender		Age Group			
	Male	Female	18-29	30-39	40-49	50+
Risk Perception	54.17 (1.23)	61.10 (1.18)	55.38 (1.58)	57.79 (1.58)	57.49 (1.71)	59.89 (1.92)
Sensation Seeking	23.92 (.71)	19.53 (.68)	22.21 (.91)	21.71 (.91)	22.36 (.98)	20.62 (1.11)
Hazard Perception	50.37 (1.63)	52.25 (1.57)	49. 33 (2.1)	51.63 (2.1)	53.33 (2.27)	50.94 (2.55)
Intended Compliance	4.59 (.09)	4.78 (.09)	4.44 (.12)	4.67 (.12)	4.85 (.12)	4.53 (.14)

Note: * *p*<.05, ***p*<.01, *** *p*<.001.

Age group

The analysis revealed no significant effect of age group on risk perception, sensation seeking and hazard perception. The effect of age group on intended compliance narrowly missed significance $F(1,144) = 2.41$, $p = .07$, $\eta^2 = .05$.

Gender

The analysis revealed a significant effect of gender on risk perception, $F(1,144) = 16.63$, $p < .001$, $\eta^2 = .10$. Female participants gave higher risk perceptions than male participants. The analysis revealed a significant effect of gender on sensation seeking, $F(1,144) = 20.10$, $p < .001$, $\eta^2 = .12$. Female participants had lower sensation seeking scores than male participants. There was no significant effect of gender on hazard perception or intended compliance nor was there any significant interaction between age group and gender for any of the dependant variables.

2.4 Discussion

The aim of the present study was to investigate the potential relationship between warning perception and risk-taking propensity. The prediction that the various measures of risk-taking propensity would be related to warning perception of the basic iconic features of visual and auditory warnings was partially supported by the data. As expected, scores representing high risk-taking propensity on some (but not all) of the measures implemented were related to low hazard perception and intentions to comply with the warnings. The results are summarised followed by a discussion of each measure of risk-taking propensity separately.

Hazard perception was predicted by scores on the risk perception scale and the BART. Individuals who gave low appraisals of general risky behaviours, perceived lower levels of hazard from the warning stimuli than individuals who gave high risk appraisals of the same behaviours. Inversely, participants with high BART scores (people who behaved riskily on the task) perceived the warnings to be lower in hazard than those with low scores. The two variables appear to be relatively equal in their prediction of hazard perception.

Impulsiveness, risk perception, behavioural inhibition and sensation seeking were all related to participants' intentions to comply with the stimuli. However only risk perception and impulsiveness significantly predicted intentions to comply when entered into a multiple regression. Impulsiveness was found to be the strongest predictor of intended compliance with highly impulsive participants reporting lower intentions to comply with warnings. Risk perception, on the other hand was positively related to intended compliance, with high risk perceptions of general risk behaviours leading to higher compliance intentions. Sensation seeking and behavioural inhibition did not offer any more prediction of intentions to comply, other than that offered by risk perception and impulsiveness.

It can be noted that more of the measures of risk-taking propensity were related to intended compliance than were related to hazard perception. This implies that risk-taking propensity may have less effect on the way that people perceive the level of hazard implied by the iconic features of the warning, whilst still affecting their intentions to comply. High risk-takers may perceive the iconic features of warnings in the same way as low risk-takers, but may be less willing to comply with them. This finding may also be explained by the fact that risk-taking propensity may represent an overestimation of potential reward of non-compliance rather than underestimation of the risks involved (e.g. Rosenbloom, 2003). High risk-takers may not necessarily see the risks from unsafe behaviour differently, but may attribute those behaviours with higher rewards.

Sensation Seeking

Sensation seeking scores were not related to hazard perception but were to intentions to comply. This implies that sensation seeking may have little effect on the way that people perceive the level of hazard implied by the iconic features of warnings, but does affect their intentions to comply. Sensation seeking independently predicted intentions to comply; sensation seekers may perceive the warnings as conveying the same level of hazard as low sensation seekers but may be less willing to report intentions to comply due to other reasons. This finding is consistent with the notion that high sensation seekers do not perceive risks (or representations of risks) differently to low sensation seekers (Zuckerman, 1994). Indeed Horvath and Zuckerman (1993) suggested that sensation seekers' lower risk perceptions appear to be a product of and not a precursor to their risky behaviour. For example, high sensation seekers may associate non-compliance with greater rewards than low sensation seekers; or it may even be the case that high sensation seekers wanted to present themselves in a non-conformist light whilst responding during the study, given that sensation seeking is associated with nonconformist attitudes (Zuckerman & Link, 1968). However, when entered in a regression with the other potential predictors, sensation seeking did not explain any more of the variance in intended compliance than that which was explained by risk perception and impulsiveness.

Impulsivity (Impulsiveness and Venturesomeness)

Impulsiveness was the strongest predictor of intentions to comply, however it was not related to hazard perception. Participants with high impulsiveness scores held lower intentions to comply with the warnings than participants with low impulsiveness scores. By definition impulsive people engage in behaviour without thinking or considering the risk involved (Caci, Nadalet, Baylé, Robert, & Boyer, 2003). Therefore, the impulsive individuals' appraisal of hazard impulsiveness may have little influence on whether or not they will comply with a warning as they may react without thinking about the risk involved. The finding that impulsivity is related to intentions to comply but not hazard perception is consistent with research in this area which has seldom found impulsiveness to predict risk perception (e.g. Haase & Silbereisen, 2011; Horvath & Zuckerman, 1993).

Venturesomeness however was not found to be significantly related to warning perception. This finding is somewhat unexpected considering the similarities between venturesomeness and sensation seeking and its relation to risk perception (Twigger-Ross & Breakwell, 1999). It seems that sensation seeking may measure a slightly different conceptualisation of risk-taking propensity that is related to warning perception, which is not captured by venturesomeness. The items in the venturesomeness scale mostly refer to behaviours and attitudes considered under the thrill and adventure seeking scale of the SSS-V, therefore venturesomeness excludes aspects of risk-taking that load on the experience seeking, boredom susceptibility and dis-inhibition subscales.

Risk Perception

The risk perception scale was the only measure to significantly predict both hazard perception and intentions to comply with the warnings. Participants who perceived high levels of risk from the behaviours in the risk perception scale perceived higher levels of hazard from the warnings and held higher intentions to comply with them. This finding suggests that the way an individual perceives general health risks (e.g. substance use and risky sex) may tell us something about the way that an individual will respond to warnings and provides support for the existence of a general tendency in some individuals to perceive low risk.

Behavioural Inhibition and Activation

Behavioural inhibition scores were negatively related to intended compliance only, however the construct did not explain any more of the variance in intended compliance than risk perception or impulsiveness. The system that this scale represents is associated with avoidance behaviours and sensitivity to punishment so it may be the case that individuals high on this scale do not perceive a difference in hazard level conveyed by a warning but are more concerned with avoiding negative outcomes or punishment, reflected by their higher intentions to comply.

None of the behavioural activation scales were related to either warning perception variable. An explanation for these findings may be that as the BIS and BAS rely on separate biological and cognitive structures, (Gray, 1982), the avoidance system may be more influential in the decision to comply with warnings. The warnings implemented revealed no situational information to appeal to participants' sensitivity to reward (BAS). It is well known that warnings are intended to mitigate the effects of a potential hazard and non-compliance may lead to undesirable consequences, (e.g. harm or loss from the hazard itself or punishment from authority). Even without any contextual information the warnings may appeal to individuals who are sensitive to punishment, whereas people who are sensitive to reward may need more contextual information to decide if the rewards of non-compliance are worth the risk of negative consequences.

Balloon Analogue Risk Task

The BART scores significantly and negatively predicted hazard perception only. People who behaved riskily on this analogy of risky behaviour did perceive the warnings to convey less hazard than people who were risk averse on this task, but this did not lead to lower intentions to comply with the warnings. Behaviour on this task may be strongly related to risk perception in that the individual must evaluate the risk of the balloon bursting every time they inflate it by an increment, therefore scores may be more strongly related to risk perceptions than actual risk behaviour due to the analogous nature of the task.

The BART was the only behavioural task used, however its validity as a true measure of risk-taking is questionable. As the task generally presents participants with 30 balloons, and the most commonly examined variable is the average score across those balloons as prescribed by the authors. Initially the task does rely on risk perceptions however as the task progresses feedback from previous trials (how large the balloon got before it burst) influences future decision therefore it can be considered a measure of learning (Rolison, Hanoch, & Wood, 2011).

Risk-Taking Propensity Scale

The risk propensity scale was not found to be related to either warning perception variable. The scale consists of seven items and is fairly transparent in that it directly asks the participant to report how much of a risk-taker they think that they are. It could be argued that this is not a valid way to measure risk-taking propensity as its transparency leaves it more open to demand characteristic than other scales. Participants may feel that they are a high risk-taker (perhaps in comparison to their friends who may have extremely low risk-taking propensities), but in reality do not have a willingness to engage in many risky behaviours. The scale was implemented in the study as it is 'quick and easy' with high face validity however it may be an inappropriate measure of risk-taking propensity.

Risk Behaviour Scale

The risk behaviour scale was not significantly related to either warning perception variable. One explanation for this is that the scale itself may not have been an accurate measure of risk-taking propensity. The scale asked participants to report the frequency that they have engaged in the risky behaviours. There are a number of issues with this method. Firstly, participants many not have had the opportunity to engage in such behaviours, despite a willingness to do so. Secondly, the term 'frequently' is fairly subjective, what may be considered frequent for one person (and one behaviour) may be considered infrequent by another (e.g. frequently smoking cannabis could mean every weekend to one person and every day to another). Indeed quantification of these terms may vary between high and low risk-takers. Third, there is a reliance on the participant to accurately recall their behaviour in the last two years, which may be difficult for some individuals (Ladouceur et al., 2000) making their responses inaccurate. To avoid these potential biases other measures of risk behaviour have asked participants the *likelihood* of engaging in certain behaviours, for example the DOSPERT scale (Weber et al., 2002).

Demographics

As expected there was a relationship between gender and risk perception and sensation seeking. Consistent with previous research (e.g. Finucane et al., 2000; Flynn et al., 1994; Zuckerman, 1979; Zuckerman & Neeb, 1980) males were higher in sensation seeking and held lower risk perceptions than females. The finding that gender did not affect either warning perception variable is inconsistent with the majority of warning literature. For example, Leonard, Hill and Karnes (1989) found women have higher hazard perceptions of warnings than men. However there is contradictory evidence within the area.

Unexpectedly age group did not affect risk perception, sensations seeking and hazard perception. The effect of age group on intended compliance narrowly missed significance. These findings are inconsistent with research in this area (e.g. Lehto & Foley, 1991; Leonard et al., 1989; Zuckerman, 1994). An explanation for this may come from the way that participants were recruited for the study. As a wide age range was sought, participants were partially recruited though adverts around the campus of the University of Plymouth and on staff web pages. This method was implemented to obtain a large number of participants over the age of 30, whilst the majority of younger participants were recruited for course credit. The adverts outlined the nature of the study (i.e. that it investigated risk-taking propensity). This may have led to an over representation of high risk-takers in the older population (who did the study out of interest), but not in the younger population (who wanted the course credit).

In summary, the present study has established that some individual differences in risk-taking propensity and attitude do affect the way people perceive warnings and should be considered as personal variables in warning models and in warning design. The warning stimuli consisted of basic visual warning symbols and non- verbal auditory warnings so that the effects of risk-taking propensity of the iconic features of warnings could be explored. The finding that risk-taking propensity was significantly related to judgement of warnings with no referent gives rise to two most palpable explanations. First, it is possible that the ratings were made on a purely perceptual level, from the features that make up the warning, (e.g. the colour or shape in the case of visual warnings), implying that risk-taking propensity affects this perceptual judgement of warnings. High risk-takers may have a lower arousal threshold for perceptual features. Second, the participants' judgements may be coloured by associations with pre-existing warnings. It is possible the warnings could be associated with a particular type of hazard, for example, the auditory warnings used in the present study were not dissimilar to alarms implemented in everyday life, and the visual warnings may resemble warnings previously seen on products or road traffic signs. It may be the case that unidentified contextual associations influence the relationship between risk propensity and judgement of warnings, or that the participants were responding to a general, generic notion of warning.

Although the present study was intended to investigate perceptions of the iconic features of a warning, this approach may explain the relatively small amount of variance in warning perception explained by the measures (approximately 10% for both dependant variables). As warnings are designed to merely calibrate individuals utility judgements when interacting with a potential hazard, the nature of (and an individual's perceptions and expectations of) the hazard itself has far more influence over compliant behaviour than the warning itself (DeJoy, 1999; Edworthy, 1998). Therefore implementing warnings which refer to a context may lead to larger effects of risk-taking propensity. Another explanation for the relatively small effect sizes may be due to the measures of risk-taking propensity themselves. The constructs used here assess general risk-taking however there is evidence to suggest that risk-taking is domain specific (e.g. Weber et al., 2002) as discussed in Chapter One.

In conclusion, the present study demonstrates the potential for certain measures of risk-taking propensity to affect warning perception. For these findings to be applied to warning design and implementation, further examination of the relationship between risk-taking propensity and warning perception is needed. It appears so far that the design features of a warning may not have a relatively strong influence on this relationship, however, only the iconic features of the warning were examined. Informational and situational design features must be explored, as well as the potential theoretical underpinnings of the relationship between risk-taking propensity and warning perception before concrete recommendations can be made. The following chapter presents two studies which examine the extent to which the relationship between risk-taking propensity and warning perception is domain specific by implementing domain specific risk-taking propensity measures and contextual warnings from different domains of risk behaviour.

Chapter Three

Exploring the Extent to which the Relationship between Risk-Taking Propensity and Warning Perception is Domain Specific

3.1 Introduction

Study 1 revealed clear evidence to suggest that certain measures of risk-taking propensity can predict warning perceptions, in particular intentions to comply with auditory and visual warnings. Although a relationship between risk-taking propensity and warning perception was established, the relatively small percentage of variance explained suggests that it is not a strong relationship.

The approach adopted during that study may partly be responsible for the strength of the observed relationship. As the previous study was exploratory in nature, the measures of risk-taking propensity implemented were chosen to assess fairly general constructs of risk-taking propensity. Also, the study aimed to establish the relationship between risk-taking propensity and warning perception using the iconic features of warnings only. The warnings implemented were simplistic, containing no contextual information and it was assumed that participants based their perceptions on the warning design features that were manipulated (e.g. the colour, shape, pitch, volume etc.). While this approach was necessary to establish differences in perceptions of warning design features, it seems fairly intuitive that the specific context of a warning will also affect the way in which people interact with it. As discussed in Chapter One, warnings are designed to calibrate individuals' judgements when interacting with a potential hazard (e.g. Edworthy, 1998). It has been suggested that the nature of the hazard or situation a warning refers to has a large influence over how the warning is perceived. Indeed, DeJoy stated that "there is little data to suggest that even the best designed warning will override the beliefs and expectations that the individual brings to the situation" (1991, p. 1044). Such beliefs about the hazard itself determine how a person will interact with an associated warning. For example, the more hazardous a product is believed to be, the more willingly an associated warning is read (e.g. Wogalter et al., 1991). Similarly, Vredenburgh and Cohen (1995) found that skiers and scuba divers who believed their respective recreational activities to be low in danger were less likely to comply with warnings encountered on ski slopes and dive centres than those who perceived the activities to be dangerous.

While risk-taking propensity may have a small effect on perceptions of simplistic warnings it may have a larger effect on perception of the context of a warning. Therefore, an approach which implements warnings that refer to a specific hazard or behavioural context may yield larger effect sizes. In addition, such an approach is likely to better represent people's perceptions and intentions toward warnings in real life settings, where warnings are almost always contextual in nature.

As previously mentioned, the first study implemented measures designed to capture a broad range of risk concepts, many of which assess fairly general manifestations of risk-taking propensity. It is unlikely that high risk-takers approach each and every risk in the same way, and few individuals appear to be consistently risk-seeking (or risk-averse) across all situations and areas of risk. The extent to which someone is risk-seeking or risk-averse (risk attitude; Weber et al., 2002) is conceived as trade-off between perceived risk and expected benefits of the behaviour in question.

Individual differences in risk attitude arise from different perceptions of the risks and benefits of a particular hazard, resulting from many factors including previous experience with or level of knowledge of the hazard or risk. There is evidence that individuals tend to attribute different weightings to risks and benefits within different domains of risk. Supporting research has found that willingness to take risks in one situation is not completely predictive of risk-taking behaviour in others (Hanoch et al., 2006; MacCrimmon & Wehrung, 1986; Schoemaker, 1990; Weber et al., 2002). Hanoch et al. found that individuals who took high recreational risks (e.g. bungee jumpers, sky divers and scuba divers), showed a moderate preference for other types of risk (e.g. financial risks such as investment and gambling). Similarly, MacCrimmon and Wehrung (1986; 1990) found that business managers' attitudes towards risk are not consistent across financial and recreational risks.

To account for such intra-individual differences, Weber et al. (2002) amongst others have asserted a domain-specific approach to studying risk-taking propensity. The Domain-Specific Risk-Taking scale (DOSPERT; Blais & Weber, 2006; Weber et al., 2002) examines risk attitudes across five domains: Ethical, Financial, Social, Health/Safety, and Recreational. The scale measures risk behaviour (as reported likelihood of engagement in risk behaviour) as well as risk perceptions and expected benefits associated with the behaviours in each domain. Using this scale, Blais and Weber, (2006) found that variation in individuals' risk-taking across domains was considerably larger than the variation in risk-taking between participants.

The DOSPERT has been shown to hold construct validity, based on its associations with established risk measures such as the SSS-V, dispositional risk-taking, and a risky gambling task (Weber et al., 2002). Further verification arises from its relationship to frequencies of self-reported risk behaviour within each domain (Weber et al.) as well as actual behaviour. For example, unpublished data has found that the health & safety and the recreation domains of the DOSPERT accurately predicted the alcohol consumption of high-school students using estimated blood alcohol concentration (see Blais & Weber, 2006). General trait measures which appear to predict risk attitude (for example, sensation seeking; Zuckerman, 1994) are suggested to do so indirectly, through perceptions of risks and benefits (Weber et al.). Sensation-seeking was found to be significantly correlated with risk-taking across all five of the domains within the DOSPERT the strongest relationship being between the thrill & adventure seeking subscale of SSS-V and the recreational behaviour subscale of DOSPERT ($r=.56$).

Given the proposed domain-specific nature of risk-taking propensity, it is plausible that the relationships observed in Study One may also be domain specific and therefore stronger if domain-specific measures are implemented. In order to examine this hypothesis, the two studies presented within this chapter used the DOSPERT as a measure of risk-taking propensity. The warnings implemented in the present study were contextual in nature, meaning they referred to particular hazards. In order to examine the extent to which the relationship between risk-taking propensity and warning perception is domain specific, the contextual information for the warning stimuli were chosen to represent the different domains of risk featured in the DOSPERT.

It is difficult (and inappropriate) to construct warnings for each of the domains of behaviour represented in the DOSPERT. For example, we rarely receive warnings of risk within social or ethical domains explicitly in the form of signs and labels whereas it is very common for warnings to represent risk from the health & safety domain. For example, warnings often represent a safety hazard in the work place (e.g. dangerous industrial machinery), or in public (e.g. to indicate a slipping hazard on a wet floor, or a road sign indicating a particular hazard like a sharp bend or hidden dip), or on a particular product (e.g. cigarette packets or household appliances). Similarly, warnings can often be found to relate to risky recreational activities. For example warnings are often found around the coastline to notify divers, surfers and other water sport enthusiasts of hazardous conditions. Warnings can be found in areas where recreational risk-taking takes place, e.g. on ski slopes, diving centres (Vredenburgh & Cohen, 1995) and on extreme sports equipment such as parachutes for skydiving.

Study 2 aimed to demonstrate the domain specificity of the relationship between risk-taking propensity and warning perception by comparing scores on the DOSPERT with warning perceptions to health & safety and recreational warnings. While these two domains were thought to represent common warnings, there was concern that the two domains were too similar in terms of the potential outcomes. Risk-taking in both the health & safety and recreational domains may result in a similar negative consequence, physical injury/death. Research shows that financial risk-taking in particular is not predictive of other types of risk-taking (Hanoch et al., 2006; MacCrimmon & Wehrung, 1986). Recently, warnings have focused on financial behaviours and can be found in applied settings as well as being implemented in psychological research (e.g. Floyd, Whelan, & Meyers, 2006; Steenbergh, Whelan, Meyers, May, & Floyd, 2004). The Consumer Credit Act in the UK requires warning messages to be printed in mortgage and loan contracts. Also in some countries (e.g. Spain, Canada and Australia) gambling warnings can be found on fruit machines. For these reasons the financial domain was deemed an appropriate domain for comparison.

Study Three aimed to demonstrate the domain specificity of the relationship between risk-taking propensity and warning perception by comparing scores on the DOSPERT with warning perceptions to health & safety and financial warnings.

Both studies employed an identical methodology; participants were required to complete the DOSPERT and the warning stimuli and measures of warning perception were designed and implemented in the same way for each study.

The contextual information for the warning stimuli was chosen on the basis of pilot selection. Both the design features of the warning stimuli and the contextual information were carefully manipulated to produce warnings which varied in their hazard level. This made it possible to examine the extent to which the design features and the contextual features contribute to participants' hazard perceptions and intentions to comply with warnings. As previously mentioned, it is thought that the hazard itself has a larger influence over warning perceptions that the warning design features (DeJoy, 1999). A secondary aim of both studies was to explore the potential interaction between warning design and the context. It was predicted therefore that the contextual information would be more influential for warning perceptions than the design features.

It was predicted that the present studies would replicate the findings of Study One in that the measures of risk-taking propensity would significantly negatively predict warning perceptions. It was also expected that the strengths of these relationships should be larger when using contextual warnings than they were using simplistic warnings in Study One.

The main prediction of the present study was that the relationship between risk-taking propensity and warning perception would be stronger when the domain of risk-taking propensity was congruent with the domain of the warning than when it was incongruent. For example, health & safety risk-taking propensity would be a stronger predictor of warning perceptions to health & safety warnings than the other four domains of risk-taking propensity, and recreational risk-taking propensity would be the strongest predictor of warning perception to recreational warnings.

The previous study found that more variance was explained by intentions to comply than by hazard perception. On this basis, it was also predicted that the risk-taking propensity measures would explain more variance for intentions to comply than for hazard perception.

3.2. Study Two: Recreational Vs. Health & Safety Warnings

3.2.1. Pilot Study

The aim of the pilot study was to select behavioural contexts for the warnings to be implemented during the main study. Half of the contexts were taken from the items within the DOSPERT scales (item-relevant) and half were selected by the researcher (item-irrelevant) to represent risks from the same domains. Implementing behaviours directly from the DOSPERT alone would not validly meet the aims of the study as responses to the same behaviours are likely to be similar whether presented as an item in a questionnaire or as the referent of a warning. For example, if a participant reports in the DOSPERT that they are likely to drink-drive it would not be surprising if they were to report lower intentions to comply with a warning about drink driving than someone who reports in the DOSPERT that they are not likely to drink drive. Therefore, it is important to establish whether any relationships found between risk-taking propensity within a domain and warning perception could be generalised to other behaviours within that domain. To do this validly it is important that the item-relevant contexts and the item-irrelevant contexts were approximately matched in terms of their perceived risk level. The pilot study was carried out in an attempt to ensure that the relative risk levels were matched across item relevance and domain.

3.2.1.1. Method

Participants

Thirty nine participants (18 males and 21 females) aged 18 to 63 (M= 33.43, SD= 13.36) were recruited by opportunity sampling (that is participants were selected on the basis of convenience; they were colleagues and associates of the researcher).

Materials

For each of the two domains (health & safety and recreational), 19 behaviours were selected (the six item-relevant and 13 item-irrelevant contexts). The larger number of item-irrelevant behaviours was selected to allow more variation and therefore more accurate risk level matching between item-relevant and item-irrelevant behaviours. The behaviours chosen for the potential warning contexts are outlined here.

Health & Safety
Item-relevant

1. Drinking heavily at a social function
2. Engaging in unprotected sex
3. Driving a car without wearing a seat belt
4. Riding a motorcycle without a helmet
5. Sunbathing without sunscreen
6. Walking home alone at night in an unsafe area of town

Item-irrelevant

1. Smoking 20 cigarettes a day
2. Running a red light at a train crossing
3. Exceeding the recommended dose of painkillers in 24 hours
4. Drinking more than the recommended units of alcohol a week
5. Driving under the influence of alcohol
6. Crossing a dual carriageway without using a pedestrian crossing
7. Using an electrical appliance near water
8. Listening to music above 90db for a prolonged period of time
9. Eating fish one week out of date
10. Driving at 50 mph in a residential area
11. Inserting a metal object into a toaster whilst in use
12. Using heavy solvents in an unventilated area
13. Using bleach based cleaning products without wearing protective gloves

Recreation
Item-relevant

1. Going camping in the wilderness
2. Going down a ski run that is beyond your ability
3. Going white-water rafting at high water in the spring
4. Taking a skydiving class
5. Bungee jumping off a tall bridge
6. Piloting a small plane

Item-irrelevant

1. 'Tomb-stoning' or cliff diving
2. Riding a horse bareback (without a saddle)
3. Mountain climbing in unknown weather conditions
4. Swimming at a beach not manned by life guards
5. Paragliding on a rainy day
6. Rock climbing without a safety harness
7. Engaging in a high contact martial art
8. Back-packing in a politically unstable country
9. Taking an inflatable out to sea
10. Attempting stunts or tricks while skateboarding without protective gear
11. Deep scuba diving (over 30 meters)
12. Water-skiing at a holiday resort
13. Hitch-hiking alone

Procedure

The behaviours were presented in a random order within two lists so that each domain was presented separately. Participants were asked to rate each one in terms of their level of risk or 'dangerousness'. Participants were given a 10 point likert scale from 'Not at all risky' to 'Extremely risky' to aid their judgements.

Analysis and Results

The mean score for each of the 38 behaviours was calculated, the behaviours were then combined and rank ordered on the basis of these scores (see Appendix 3A). The divided into thirds and designated as high, medium and low risk behaviours on the basis of the participant's ratings. The high group consisted of 12 behaviours with means that ranged from 9.18 to 7.2, medium consisted of 13 behaviours with mean ratings of 6.93 to 5.68 and the low group consisted of 12 behaviours ranging between 5.63 and 3.53.

The item-relevant behaviours were rank ordered and categorised as high, medium and low risk on the basis of their position in the rank ordered behaviours. A high, medium and low hazard example was selected for each domain and was then matched to an item-irrelevant behaviour of a similar hazard level. This resulted in six behaviours for each domain (three item-relevant and three item-irrelevant). The behaviours that were chosen are displayed in Table 3.1 and were used as contexts for the warnings implemented in the main study.

Table3.1 The Behaviours and Mean Risk Ratings Selected for the Warning Stimuli

Risk level	Item-relevant	Rating (M)	Item-irrelevant	Rating (M)
Health/Safety				
Low	Drinking heavily at a social function	4.70	Drinking more than the recommended units of alcohol a week	4.35
Medium	Driving a car without wearing a seat belt	6.75	Crossing a dual carriageway without using a pedestrian crossing	6.75
High	Riding a motorcycle without a helmet	8.33	Driving under the influence of alcohol	8.9
Recreation				
Low	Piloting a small plane	4.93	Riding a horse bareback (without a saddle)	4.8
Medium	Going white-water rafting at high water in the spring	6.58	Taking an inflatable out to sea	6.6
High	Going down a ski run that is beyond your ability	7.45	Rock climbing without a harness	7.4

3.2.2. The Main Study

3.2.2.1. Method

The study was conducted using different settings; one was laboratory based, the other was conducted over the internet. Any differences in procedure between the two settings are detailed here.

Participants

Lab study

Lab-based participants were recruited though the University of Plymouth paid participants pool. A total of 44 participants aged 19-63 (mean age= 27.36, SD= 8.79) completed the study, of these 24 were female and 20 were male.

Internet study

Internet-based participants were recruited by an internet study is advertised with the request that the participant pass on the details of the study to other potential participants for a potential financial reward (Gardner, 2009). Participants were recruited using national postgraduate research networks, advertising within the University of Plymouth online community, and online social networking interfaces. A prize draw of £40 was offered as an incentive for participation in the study and a prize of £20 was offered to the participant who recruited the highest number of other participants.

A total of 236 participants aged 18-74 (M=29.14, SD= 12.23) completed the internet study, of these 153 were female and 83 were male.

Materials

The DOSPERT (Adult) scale (Blais & Weber, 2006) is made up of three subscales; risk behaviour (the likelihood of engaging in risk behaviour), risk perception, and expected benefits. All subscales feature the same items; these are behaviours of varying risk levels which fall under five different categories or domains of risk; social, recreational, financial, health & safety and ethical. The scale is a shortened version of the original DOSPERT scale developed by Weber et al. (2002) containing 30 items in each subscale instead of 40. Blais and Weber (2006) argued that this version of the scale is more accessible to a wider range of respondents from a range of demographic groups including age, culture and education level. Blais and Weber did not include the benefits scale in this paper. As the perceived benefits may be theoretically important (the motivations behind different risks may be different, for example, the benefits may be more important to the recreational domain than health & safety), the benefits scale was included here and was based on the items in the shortened scales (Hanoch & Gummerum, 2011). See Appendix 3B for the all three scales of the DOSPERT that were used in this study.

The Warning task involved presenting participants with all 27 visual warning labels in a random order (24 experimental warnings and three practice trials where no recorded). The warnings were randomly presented one at a time and participants' hazard judgement and intentions to comply were measured for each warning in the same manner as the warning task in Study 1.

The warning stimuli were in the form of warning labels and were designed using Corel® Paint Shop Pro® Photo X2. The labels were of a very similar format to that prescribed by the American National Standards Institute (ANSI Z535.2, 2002). The labels consisted of approximately 15 cm x 10 cm rectangles with a 3.5cm x 15cm coloured header above a 6.5cm x 15 cm message box. The label outlines were black and had a width of 15pts. The coloured header contained a pictorial and signal word in white against the back ground. The pictorial consisted of a simple shape containing an exclamation mark. The exclamation mark and the signal word were typed in capitals in Arial Black (Bold) font with the former at 48pts and the latter at 65pts. The full set of warning stimuli can be found in Appendix 3C.

The warning messages were constructed from the behaviours selected during the pilot study (see Table 3.1). The message included a statement about the nature of the hazard, a statement about the consequences of not following the warning and instructions for mitigating the consequences of the hazard (e.g. Sanders & McCormick, 1993; Wogalter et al., 1992a). The font for the message section of the warning was Helvetica (Bold) in font size 21.

The design features of the warnings were manipulated so that for each behaviour there was a high hazard example and a low hazard example. See Figure 3.1 for illustration of a high and a low warning with the same contextual information. For the high hazard example the signal word was 'Danger' and for the low hazard example it was 'Caution'. For the pictorial the high hazard shape was a triangle and the low hazard shape was a circle, both were approximately 4cm x 4cm. the background colour was red (r:225, g:0, b:0, o:225) for high hazard and blue (r:0, g:0, b:192, o:225) for the low hazard warning. The wording of the message was also manipulated with as much control as possible. The statement about the nature of the hazard varied in terms of its definitive or probabilistic nature (e.g. 'driving without a seat belt *is* dangerous' vs. 'driving without a seat belt *may be* dangerous') as this has been found to affect hazard perception (Costello et al., 2002). The consequences of not following the warning also varied in terms of their level of probability (e.g. 'if a collision occurs there is a *high risk it will be* fatal' vs. 'if a collision occurs it *may be* fatal') as this has been found to increase intentions to comply (e.g. DeTurck & Goldhaber, 1989). Due to the variable nature of the behaviours it was very difficult to maintain complete consistency over the wording of the message. However as far as possible these features were kept constant, for example, the nature of the hazard was always described as 'dangerous', and the explicitness of the message was kept as constant as possible. No personal pronouns or numerical statistics (e.g. 'there is a high risk' vs. 'the risk is twice as large') were used, and the instructions for mitigating the consequences began with explicit adverbs (e.g. 'never' instead of 'avoid').

Figure 3.1. An Example of a High and a Low Hazard Warning for the Same Behaviour

Procedure

During the lab study, participants sat at individual desk in front of computer screens and were briefed. They then completed the two tasks (the warning task and the DOSPERT), the order of which was balanced. On completion of the three tasks the participants were debriefed.

During the internet study participants completed the study hosted on the University of Plymouth's psychology research website (http://www.psy.plymouth.ac.uk/). Participants were briefed on screen and indicated their consent by checking a box before continuing to the study. The DOSPERT and warning task were balanced by participant number (odd numbers were presented with warning task first, even with DOSPERT first). On completion participants viewed a debrief on screen and were given a reference number and contact details of the researcher.

3.2.2.2. Results

To ensure that the data from the laboratory study and the internet study could be combined into a homogenous data set for the main analyses, MANOVAs were carried out with recruitment method as the independent variable. The results of these analyses can be found in Appendix 3D. As the majority of the means did not significantly differ between the two recruitment methods, the two data sets were combined for further analysis N=280, age = 18-74, M (SD) =28.86 (11.76), Male = 103, Female =177.

Reliability and manipulation checks were also carried out on the data. The results of these analyses can be found in Appendix 3E. The results suggest that the measures were reliable and the intentions of the pilot study (to identify behaviours which were approximately matched in terms of their hazard level across item-relevance and domain) were successful.

The Relative Influence of Contextual and Design Features on Warning Perceptions

To address the first prediction that contextual information given in the warnings would be more influential for warning perceptions than the design features that were manipulated a 2 (design features; high vs. low) x 3 (context; high vs. medium vs. low) repeated measures ANOVA was conducted for each dependant variable (hazard perception and intended compliance). The collapsed across warning domain. The analysis also allowed confirmation that the participants perceived the design and contextual features as predicted during the design process. See Table 3.2 for the mean and standard error for hazard perception and intended compliance.

Table 3.2 The Mean and Standard Error of Design and Contextual features for Hazard Perception and Intended Compliance

Hazard Perception	Hazard Level	Mean	SD
Design	High	70.63	.96
	Low	58.16	1.17
	High	72.58	1.0
Context	Medium	66.08	1.05
	Low	54.54	1.13
Intended Compliance			
Design	High	5.52	.05
	Low	5.13	.06
	High	5.95	.05
Context	Medium	5.50	.06
	Low	4.52	.07

For hazard perception, Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of context, $\chi^2(2)=36.14$, $p<.001$. Therefore the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon=.89$ for context).

The analysis revealed a highly significant main effect of design features (the high hazard warning design vs. low hazard warning design), $F(1, 279)= 213.07$, $p<.001$, $\eta p^2 = .433$. As intended, the high hazard warnings were rated as significantly more hazardous than the low hazard warnings by participants.

There was a significant main effect of contextual information, $F(1.78, 479.36)= 332.43$, $p<.001$ $\eta p^2 =.544$. Bonferroni pairwise comparisons revealed that this effect reflected significant differences between all three levels of contextual information; high, medium and low hazard contexts (all p's<.001). Therefore the participants did perceive the design and contextual features as intended. There was also a small but significant interaction between the two factors context and design, $F(2, 558)= 28.25$, $p<.001$, $\eta p^2 = .09$. The difference between the high and low design features was smaller for warnings depicting low hazard behaviours.

For intended compliance, Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of context, $\chi^2(2)=45.51$, $p<.001$, and for the interaction between context and design $\chi^2(2)=410.93$, $p<.01$. Therefore the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (ε =.89 for context and ε =.96).

The analysis revealed a highly significant main effect of design features (the high hazard warning design vs. low hazard warning design), $F(1, 283)= 100.56$, $p<.001$ $\eta p^2 = .265$. Participants gave higher intentions to comply with the high hazard warnings than the low hazard warnings.

There was also a highly significant main effect of contextual information, $F(1.74, 484.79)= 384.9$, $p<.001$ $\eta p^2 = .58$. Bonferroni pairwise comparisons revealed that this effect reflected significant differences between all three levels of contextual information; high, medium and low hazard behaviours (all p's<.001). There was a significant interaction between the two factors, $F(1.93, 537.29)= 31.46$, $p<.001$ $\eta p^2 = .10$. Again the difference between high and low design features was smaller for warnings depicting low hazard behaviours.

The participants' rating for hazard perception and intended compliance reflected the predicted hazard levels of the contextual information and warning design features.

Examination of the Subscales and Domains of the DOSPERT

In order to check that the subscales of the DOSPERT were related, and that the correlations were stronger within each domain, a Pearson's correlation was carried out on the subscales and domains of the DOSPERT. The risk behaviour scale was negatively correlated with the risk perception scale and positively correlated with the expected benefits scale for every domain of the DOSPERT. The correlation coefficients and associated significance levels are displayed in Appendix 3F.

As Weber et al. (2002) argued that individuals' risk attitudes (their behavioural intentions) can be explained by their perceptions of the risk and their expectations of benefits from a particular behaviour, only the risk behaviour scale was implemented as the measure of risk-taking propensity in the present study. In order to confirm that risk perceptions and expected benefits did indeed predict risk behaviour for the participants in the present study, scores on the risk perception and expected benefits scale were regressed against scores on the behavioural likelihood scale in accordance with Weber et al. (2002). Hierarchical regressions were performed for each domain separately with risk perception scores in the first step, and expected benefits entered in the second. The results of the analyses for all domains are presented in Table 3.3. For every domain, risk perception scores significantly predicted risk behaviour and the addition of the expected benefits scale significantly improved the model.

As expected, in all analyses risk behaviour was negatively predicted by risk perception and positively predicted by expected benefits. This is consistent with risk-reward frameworks which state that an individual's decision to engage in a risk is driven by their perceptions of the risks and benefits involved. The results were comparable to those of Weber et al. (2002) who found the overall effect sizes ranged from .36 to .50 for each domain. While the addition of the expected benefits scale significantly improved the models for all domains of risk behaviour (the proportion of variance explained almost doubled), the change in the amount of variance explained was considerably smaller (3%) for the health & safety domain than it was for any other domain. Across all domains the expected benefits scale was the stronger predictor with the exception of the health & safety domain, where the risk perception scale was the stronger predictor. This suggests that health & safety risk-taking propensity may be more driven by risk perceptions than expected benefits in comparison with the other domains.

Table 3.3 Regression coefficients for risk perception and expected benefits scales for each domain of risk behaviour

	Domain of DOSPERT									
	Social		Recreational		Financial		Health & Safety		Ethical	
	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
Step one		.14**		.34**		.23**		.34**		.26**
Risk perception	-.38**		-.58**		-.48**		-.59**		-.51**	
Step two		.33**		.61**		.40**		.37**		.41**
Risk Perception	-.27**		-.30**		-.36**		-.51**		-.33**	
Expected Benefits	.45**		.59**		.43**		.18**		.43**	

Note: * p<.05 and ** p<.01

As risk perceptions and expected benefits did predict risk behaviour for the participants in the present study, it was deemed appropriate to use the risk behaviour scale as the sole measure of risk-taking propensity. The purpose of the scale in this context was predictive in nature, in which case Weber et al. (2002) argued that the use of a single scale is sufficient.

The Domain Specificity of the Relationship between Risk-Taking Propensity and Warning Perception

The main aim of the study was to determine if domain specific measures of risk-taking propensity were related to hazard perception and intentions to comply with domain specific warnings. In order to do so four hierarchical regressions were carried out on the data, one for each type of warning and dependant variable (hazard perception or intended compliance). The congruent domain of the DOSPERT was entered in the first step and all other domains were entered in the second. As the majority of the domains of the DOSPERT are correlated to some degree, these analyses alone do not rule out the possibility of a general factor of risk-taking propensity. In order to demonstrate that the relationship between risk-taking propensity and warning perception is domain specific beyond doubt, additional analyses were carried out where all incongruent domains were entered into a hierarchical regression in the first step and the congruent domain was added in the second. The results of these analyses are presented in Appendix 3K and where the additional analyses contrast the results of the following analyses they are discussed in this chapter.

Warnings from the Health & Safety domain

Hazard perception

For health & safety warnings, step one of the analysis revealed the congruent domain (health & safety) of risk-taking was a significant predictor of hazard perception $F(1, 279) = 51.87$, $p<.001$, $\Delta R^2 = .15$. As participants' risk-taking propensity in the health & safety domain increased, hazard perception to warnings from the congruent domain decreased.

The addition of the incongruent domains of the DOSPERT in step two did not significantly improve the amount of variance explained, F change $(4, 274)=1.46$, $p=.214$, R^2 change=.02, despite the fact that the ethical risk-taking propensity was also a significant predictor of hazard perception to health & safety warnings, t= -2.24, $p<.05$. Table 3.4 displays the coefficients for step one and two of the analysis.

Table 3.4 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Health & Safety Warnings

	b	SE *b*	β
Step 1			
Constant	84.94	2.83	
Health & Safety	-.96	.13	-.40***
Step 2			
Constant	87.56	6.15	
Health & Safety	-.77	.16	-.32***
Social	.05	.18	.02
Recreational	-.11	.12	-.06
Financial	-.05	.12	.30
Ethical	-.42	.19	-.14*

*Note: *** p=<.001, ** p=<.01, *p=<.05*

The corresponding additional analysis in Appendix 3K revealed that recreational risk-taking propensity was also a significant predictor until the addition of the congruent domain. The congruent domain remains the strongest predictor of hazard perceptions of health & safety warnings.

Intended compliance

For health & safety warnings, the congruent domain (health & safety) of risk-taking was a significant predictor of intentions to comply F (1, 279) = 189.23, p<.001, ΔR^2 = .40. As risk-taking propensity in health & safety domain increased, intentions to comply with warnings from the congruent domain decreased.

The addition of the incongruent domains of the DOSPERT did not significantly improve the amount of variance explained F change (4, 274) =1.09, p=.36, R^2 change=.01. Table 3.5 displays the coefficients for step one and two of the analysis.

Table 3.5 Regression Coefficients for Risk-taking Propensity as a Predictor of Intentions to Comply with Health & Safety Warnings

	b	SE *b*	β
Step 1			
Constant	7.00	.13	
Health & Safety	-.083	.01	-.64***
Step 2			
Constant	6.78	.28	
Health & Safety	-.08	.01	-.61***
Social	.01	.01	.08
Recreational	-.01	.01	-.05
Financial	-.00	.01	-.03
Ethical	-.01	.01	-.04

Note: *** p=<.001, ** p=<.01, *p=<.05

As expected, risk-taking propensity did predict warning perceptions to health & safety warnings and the amount of variance explained was larger for intentions to comply than for hazard perceptions. The congruent domain was also the strongest (and in the case of intended compliance, the only) predictor. The corresponding additional analysis in Appendix 3K revealed that recreational risk-taking propensity was also a significant predictor until the addition of the congruent domain. The congruent domain remains the strongest predictor of intentions to comply with health & safety warnings.

Warnings from the Recreational domain

Hazard perception

For recreational warnings, the congruent domain (recreational) of risk-taking was a significant predictor of hazard perception $F(1, 279) = 24.36$, $p<.001$, $\Delta R^2 = .077$. The addition of the incongruent domains of the DOSPERT did significantly improve the amount of variance explained F change (4, 274) =5.44, $p<.01$, R^2 change =.07. Health & Safety risk-taking propensity also significantly predicted hazard perception of recreational warnings, t= -2.48, $p<.05$, as did Ethical risk-taking propensity, t= -2.82, $p<.05$. Table 3.6 displays the coefficients for step one and two of the analysis. As recreational, health & safety and ethical risk-taking propensity increased, hazard perception of recreational warnings decreased. However the relationship was stronger and more significant for the congruent domain indicated by higher beta values.

Table 3.6 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Recreational Warnings

	b	SE *b*	β
Step 1			
Constant	77.36	2.57	
Recreational	-.51	.10	-.28***
Step 2			
Constant	86.62	6.42	
Recreational	-.33	.12	-.19**
Social	.04	.19	.20
Financial	.14	.16	.88
Health & Safety	-.42	.17	-.17*
Ethical	-.56	.20	-.18*

*Note: *** p=<.001, ** p=<.01, *p=<.05*

Intended compliance

For recreational warnings, the congruent domain (recreational) of risk-taking was a significant predictor of intentions to comply $F(1, 279) = 110.36$, $p<.001$, $\Delta R^2 = .28$. The addition of the incongruent domains of the DOSPERT did significantly improve the amount of variance explained F change (4, 274) = 7.91, p<.001, R^2 change =.074. Health & safety risk-taking propensity also significantly predicted intentions to comply with recreational warnings, t= -4.22, p<.001. As recreational and health & safety risk-taking propensity increased, hazard perception of recreational warnings decreased. Although the model was significantly improved by the addition of the incongruent domains, the relationship was stronger within the congruent domain as indicated by higher beta values. Table 3.7 displays the coefficients for step one and two of the analysis.

As expected, risk-taking propensity did predict warning perceptions to recreational warnings and the amount of variance explained was larger for intentions to comply than for hazard perceptions. The congruent domain was also the strongest predictor of intended compliance but unexpectedly not for hazard perception.

Table 3.7 Regression Coefficients for Risk-taking Propensity as a Predictor of Intentions to Comply with Recreational Warnings

	b	SE *b*	β
Step 1			
Constant	6.76	.13	
Recreational	-.06	.01	-.53***
Step 2			
Constant	7.25	.33	
Recreational	-.042	.01	-.40***
Social	.01	.01	.04
Financial	-.00	.01	-.02
Health & Safety	-.04	.01	-.25***
Ethical	-.02	.01	-.10

*Note: *** p=<.001, ** p=<.01, *p=<.05*

Generalisability of Observed Relationships

As half of the behaviours of the warnings were selected to represent items from the DOSPERT (item-relevant) and the remaining half were selected from the same domains but were not represented in the DOSPERT (item-irrelevant), it is possible that relationships observed in the following analyses may be driven solely by the repetitious nature of the item-relevant warnings. To ensure that the observed relationships are generalisable to behaviours other than those depicted in the DOSPERT, hazard perception and intended compliance to item-relevant and irrelevant-warnings was correlated with the five domains for each subscale using Pearson's correlation. The results of the analysis are presented separately for each of the three DOSPERT scales. Table 3.8 displays the correlation coefficients for the risk behaviour scale which was implemented as the primary risk-taking propensity measure.

Risk-taking propensity in the recreational domain was negatively related to hazard perception and intended compliance for item-relevant and irrelevant warnings from both the recreational and health & safety domain. Risk-taking propensity in the health & safety domain was negatively related to hazard perception and intended compliance for item-relevant and irrelevant warnings from both the health & safety and recreational domain. Although risk-taking in some domains was related to perceptions of warnings from incongruent domains, the correlations highlighted in bold in Table 3.8 show that the relationships were generally strongest within domain.

Table 3.8 Correlation Coefficients for Item-Relevant and Irrelevant Warning Perception to the Five Domains of the DOSPERT Risk Behaviour Scale

		Domain				
Warning Domain	Item-relevance	Social	Recreation	Financial	Health & Safety	Ethical
Hazard Perception						
Health & Safety	Item-relevant	-.11	-.22**	-.12*	-.41**	-.29**
	Item-irrelevant	-.09	-.23**	-.09	-.35**	-.24**
Recreational	Item-relevant	-.10	-.28**	-.10	-.27**	-.25**
	Item-irrelevant	-.13*	-.28**	-.06	-.32**	-.27**
Intended Compliance						
Health & Safety	Item-relevant	-.11	-.31**	-.20**	-.66**	-.33**
	Item-irrelevant	-.09*	-.31**	-.16**	-.54**	-.25**
Recreational	Item-relevant	-.22**	-.56**	-.20**	-.40**	-.27**
	Item-irrelevant	-.13*	-.42**	-.17**	-.44**	-.26**

Note: * p<.05 and ** p<.01

These results suggest that the observed relationships between risk-taking propensity and warning perception may be considered externally valid in the respect that they may be applied to other risky behaviours and are not limited to those prescribed in the DOSPERT.

3.2.3. Study Two Discussion

Overall the results of the present study replicate the results of Study One, in that risk-taking propensity was found to negatively predict warning perceptions. Larger effect sizes were observed when using contextual warnings in the present study, compared to the simplistic warnings implemented in Study One.

The main prediction of the present study, that the relationship between risk-taking propensity and warning perception would be domain specific, was supported to a certain extent. It was found that while some incongruent domains were related to warning perceptions, the congruent domain of risk-taking propensity was always a stronger predictor of warning perceptions than the incongruent domains. Furthermore, inspection of the correlations between scores on the domains of the DOSPERT and responses to item-relevant and irrelevant warnings suggest the observed relationships apply to both types of warning. Therefore, the effects are not merely a product of the design of the study and should extend to other behaviours within the same domain.

It was predicted that risk-taking propensity would predict intentions to comply more strongly than it would predict hazard perception, and this was confirmed by the comparison of the effect sizes for each analysis. For both health & safety and recreational warnings, the effect sizes were larger for intentions to comply than for hazard perception. This suggests that a person's individual likelihood of engaging in risky behaviours influences their intentions to comply with warnings, more than their perceptions of the hazard implied by warnings. This is comparable with the findings of study one where more risk related constructs were related to intentions to comply than were related to hazard perception.

The results support the prediction that the relationship between risk-taking propensity and warning perception is domain specific as most incongruent domains of the DOSPERT were unrelated to warning perceptions. Where incongruent domains were related to warning perceptions, it was found that the ethical domain was related to hazard perceptions of both types of warnings but not intentions to comply. The relevance of this is explained in the general discussion. It was also found that health & safety risk-taking propensity was related to both hazard perception of, and intended compliance with recreational warnings, also recreational risk-taking was related to hazard perception and intended compliance for health & safety warnings.

This is not surprising given that previous research (Weber et al., 2002), has found these to be most highly correlated of the domains DOSPERT. Indeed the present study found the relationship between these two domains of the behavioural likelihood scale was larger than all other relationships. One explanation for the similarity is that, as previously mentioned, the negative consequences of the two domains are similar. Both domains of risk have the potential to result in physical injury and/or death of the risk-taker. Therefore high risk-takers in both domains may be characterised by a tolerance of fear of physical injury. From this, one might expect to observe that recreational risk-taking would predict perceptions of health & safety warning as well but the findings of the present study reveal this is not the case. The two domains of risk-taking are similar in terms of risk but they may differ in terms of benefits. The potential rewards of recreational risk may be considered higher than those of the health & safety domains. The motivation for the recreational risk-taker, for example skiers, is to achieve the ‘rush’ of skiing down a fast slope and the sense of achievement they receive from completing a difficult run. Arguably engaging health & safety risks do not always yield the same kind of benefits, it is not as exciting to drive without a seat belt or cross a busy road. Here the motivations for risk-taking are more likely to be convenience or carelessness for example. Support for this notion was found in the present study when the risk perception and expected benefits scale of the DOSPERT were regressed against the risk behaviour scale for each domain separately. It was found that the addition of the expected benefits scale increased the amount of variance in risk behaviour explained by a considerable amount compared with that explained by risk perceptions alone, and was a stronger predictor of risky behaviour. This was true for all domains apart from the health & safety domain, where the amount of variance explained increased by approximately 3% and expected benefit was a stronger predictor. This suggests that risk-taking behaviour is more influenced by expected benefits than risk perceptions but both play a large role for all domains except health & safety, where risk perceptions play a far larger role than expected benefits.

3.3. Study Three: Financial Vs. Health & Safety Warnings

The results of the previous study revealed that the relationship between measures of risk-taking propensity and warning perception, particularly intended compliance, was stronger when domain specific measures of risk-taking were implemented. Generally, risk-taking in a domain congruent with the context of a warning predicted intended compliance while risk-taking in incongruent domains did not. However it was found that health & safety risk-taking predicted responses to both health & safety and recreational warnings. These findings may be attributed to the similarities outlined above. By comparing scores on the DOSPERT to the perception of health & safety warnings with warnings from a less strongly correlated domain, it is possible to investigate these hypotheses.

The domain which was found to have the lowest correlation with the health & safety domain during the Study Two was the financial domain (r=.249) for the behavioural likelihood scale, similarly the financial domain was found to be the second lowest correlated domain for risk behaviour scale during the construction of the DOSPERT itself (study 1, r=.46, study 2, r=.29; Weber et al. 2002) with the social domain being the least related. The items in the social domain did not naturally lend themselves to the traditional warning format used in the previous and present study (e.g. 'starting a new career in your thirties') whereas financial warnings are becoming more widely used in applied settings. It was deemed more appropriate therefore, to use the financial domain over the social to construct warnings in this study.

The following study aimed to replicate the last by comparing health & safety warnings with financial warnings rather than recreational in an attempt to examine a less related domain. The method replicated almost exactly that of the previous study, including the pilot study. Only differences between procedures are detailed here.

3.3.1. Pilot study

A second pilot study was carried out to select behaviours for the warnings to implement during the main study. The warnings created for the health & safety domain during the previous study could not be reused as it was essential that the chosen behaviours from the two domains were approximately equal in terms of their perceived risk level across domain as well as across item-relevance. It was also important that the behaviours chosen for the warning stimuli were rated by the same set of participants for continuity and validity.

3.3.1.1. Method

Participants

Thirty two participants (13 males and 19 females) aged 19 to 83 (mean age= 33.84, SD=14.95) were recruited by opportunity sampling.

Materials and procedure

As there were concerns that a British student population would not understand some of the terms used in the financial domain of the DOSPERT, some of the wording was changed slightly for some items and explanations were offered. For example, the item 'Investing 5% of your annual income in a very speculative stock' was followed by '(stock with a low probability of returns but potentially of high value)' and 'Investing 10% of your annual income in a moderate growth mutual fund' was changed to 'Investing 10% of your annual income in a collective investment fund (Investing money into a fund along with others to increase the range of investments available)'. The explanations were created by the researcher using definitions found online. In the DOSPERT, the financial domain is made up of two sub-domains; investment and gambling. The item-irrelevant behaviours were chosen to represent these two sub-domains as well as behaviours which do not fit these categories (e.g. 'taking out a store credit card to buy items you can't afford now'). The behaviours implemented in the pilot study are outlined here.

Health & Safety

Item-relevant

1. Drinking heavily at a social function
2. Engaging in unprotected sex
3. Driving a car without wearing a seat belt
4. Riding a motorcycle without a helmet
5. Sunbathing without sunscreen
6. Walking home alone at night in an unsafe area of town

Item-irrelevant

1. Smoking 20 cigarettes a day
2. Running a red light at a train crossing
3. Exceeding the recommended dose of painkillers in 24 hours
4. Drinking more than the recommended units of alcohol a week
5. Driving under the influence of alcohol
6. Crossing a dual carriageway without using a pedestrian crossing
7. Using an electrical appliance near water
8. Listening to music above 90db for a prolonged period of time
9. Eating fish one week out of date
10. Driving at 50 mph in a residential area
11. Inserting a metal object into a toaster whilst in use
12. Using heavy solvents in an unventilated area
13. Using bleach based cleaning products without wearing protective gloves

Financial

Item-relevant

1. Betting a day's income at the horse races
2. Investing 10% of your annual income in a collective investment fund (Investing money into a fund along with others to increase the range of investments available)
3. Betting a day's income at a high-stake poker game
4. Investing 5% of your annual income in a very speculative stock (stock with a low probability of returns but potentially of high value)
5. Betting a day's income on the outcome of a sporting event
6. Investing 10% of your annual income in a new business venture

Item-irrelevant

1. Buying a used car on the internet from an independent seller without viewing it
2. Putting a day's income into a fruit machine
3. Continuing to gamble in a casino to make up for losses you have already incurred
4. Entering your credit/debit card details on an unsecured internet site
5. Investing 10% of our annual income in shares of a new company
6. Taking out a large loan for a luxury item
7. Investing 10% of your annual income in an offshore bank account
8. Investing in property for development costing over 4 times your annual salary
9. Betting a month's income on a roulette wheel
10. Taking out a store credit card to buy items you can't afford now
11. Regularly betting on an internet gambling site
12. Investing a month's income in a pyramid scheme
13. Spending a day's income on national lottery tickets

3.3.1.2. Results

The 'High' group consisted of 12 behaviours with means that ranged from 9.19 to 7.41, medium consisted of 13 behaviours with mean ratings of 7.34 to 6.72 and the low group consisted of 12 behaviours ranging between 6.56 and 4.28. The final behaviours are presented in Table 3.9. The means for all behaviours can be found in Appendix 3G.

Table 3.9 The Behaviours and Mean Risk Ratings Selected for the Warning Stimuli

Risk level	Item-relevant	Risk (M)	Item-irrelevant	Risk (M)
Health/Safety				
Low	Drinking heavily at a social function	5.47	Drinking more than the recommended units of alcohol a week	5
Medium	Engaging in unprotected sex	6.56	Crossing a dual carriageway without using a pedestrian crossing	6.72
High	Driving a car without wearing a seat belt	7.31	Inserting a metal object into a toaster whilst in use	7.75
Financial				
Low	Investing 10% of your annual income in a collective investment fund	5.69	Investing 10% of your annual income in an offshore bank account	5.59
Medium	Investing 5% of your annual income in a very speculative stock	6.53	Investing 10% of your annual income in shares of a new company	6.88
High	Betting a day's income at a high-stake poker game	7.25	Regularly betting on an internet gambling site	7.53

After examination of the ratings of the DOSPERT items it was clear that the participants did not consider the behaviours from the financial domain as risky as the health & safety domain of the DOSPERT. This may be a product of cross cultural differences in risk perception as the present study was constructed in the UK, and the DOSPERT was constructed in the USA. However, it may also indicate that the behaviours within the DOSPERT scale itself are not balanced in terms of their relative risk levels across domain. During construction of the DOSPERT, Weber et al. (2002) selected the items on the basis of their factor loadings on each domain and did not attempt to approximately match the behaviours in each domain for their relative risk level. Therefore, it may be the case that the behaviours selected for the health & safety domain are actually perceived as more risky that the behaviours selected for the financial domain. The implications of this for the present study and for general use of the scale are explored in the general discussion.

Due to the number of behaviours required for the warnings design (three in each type of relevance), it was impossible to ensure that there was an equal number of investment and gambling behaviours selected within the financial domain. As this was unavoidable, one gambling behaviour and two investment behaviours were selected based on their relative risk levels. From inspection of Table 3.9 it was clear that the participants judged the gambling behaviours to be more risky than the investment behaviours even when the size of the potential losses may be similar. For example, participants judged 'investing a day's income in very speculative stock' considerably less risky than 'Putting a day's income into a fruit machine'. As the behaviours had to be matched for risk level across domain, some of the health & safety behaviours that were assigned to the medium risk group in the previous pilot study were assigned to the high risk group in the present study.

3.3.2. The Main Study

3.3.2.1. Method

Participants

Participants were psychology undergraduates at the University of Plymouth who participated for course credit. A total of 198 participants aged 18 to 49 (M=21.38 SD=5.55) completed the study, of these 164 were female and were 34 male.

Materials

The DOSPERT (Adult) scale (Blais & Weber, 2006), and the warning task were used as in the previous study. There was a small difference in the wording of the warnings stimuli. The word ‘dangerous’ was changed to ‘risky’ for all warnings as the term dangerous may not be applicable to financial behaviours as danger may suggest physical injury to some participants.

Procedure

Participants sat at individual desks in front of computer screens and were briefed. They then completed the two tasks (the warning task and the DOSPERT), the order of which was balanced. The participants were debriefed on completion. The full warning stimuli are displayed in Appendix 3H.

3.3.2.2. Results

Reliability and manipulation checks were carried out on the data. The results of these analyses can be found in Appendix 3I. The results suggest that the measures were reliable and the intentions of the pilot study (to identify behaviours which were approximately matched in terms of their hazard level across item-relevance and domain) were partially successful. The item-relevant warnings were judged the same as the item-irrelevant however, participants perceived more hazard from the health & safety warnings than from the financial ones. The implications of these findings are discussed later.

The Relative Influence of Contextual and Design Features on Warning Perceptions

To address the first prediction that contextual information given in the warnings would be more influential for warning perceptions than the design features that were manipulated a 2 (design features; high vs. low) x 3 (context; high vs. medium vs. low) repeated measures ANOVA was conducted for each dependant variable (hazard perception and intended compliance). The collapsed across warning domain. See Table 3.10 for the means and standard error for hazard perception and intended compliance.

Table 3.10 The Mean and Standard Error of Design and Contextual features for Hazard Perception and Intended Compliance

Hazard Perception	Hazard Level	Mean	SD
Design	High	61.47	1.05
	Low	49.1	1.05
	High	59.12	.99
Context	Medium	57.16	.99
	Low	49.56	1.07
Intended Compliance			
Design	High	5.27	.05
	Low	4.75	.06
	High	5.43	.06
Context	Medium	5.24	.05
	Low	4.35	.07

For hazard perception, Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of context, $\chi^2(2)=13.42$, $p<.001$. Therefore the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon=.94$ for context).

The analysis revealed a highly significant main effect of design features (the high hazard warning design vs. low hazard warning design), $F(1, 197)= 174.47$, $p<.001$ $\eta p^2 = .47$. As intended, the high hazard warnings were rated as significantly more hazardous by participants than the low hazard warnings.

There was a significant main effect of contextual information $F(1.88, 369.55)= 109.02$, $p<.001$ $\eta p^2 = .36$. Bonferroni pairwise comparisons revealed that this effect reflected significant differences between all three levels of contextual information; high, medium and low hazard behaviours (all *p's*<.01).

Therefore the participants did perceive the design and contextual features as intended. There was no significant interaction between the two factors context and design.

For intended compliance, Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of context, $\chi^2(2)=11.28$, $p<.01$. Therefore the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon=.95$ for context).

The analysis revealed a highly significant main effect of design features (the high hazard warning design vs. low hazard warning design), $F(1, 197)= 126.63$, $p<.001$, $\eta p^2 = .39$. Participants gave higher intentions to comply with the high hazard warnings than the low hazard warnings.

There was a significant main effect of contextual information $F(1.89, 373.13)= 240.32$, $p<.001$, $\eta p^2 = .55$. Bonferroni pairwise comparisons revealed that this effect reflected significant differences all three levels of contextual information; high, medium and low hazard contexts (all *p's*<.001). There was no significant interaction between the two factors.

The participants' ratings for hazard perception and intended compliance reflected the predicted hazard levels of the contextual information and warning design features.

Examination of the Subscales and Domains of the DOSPERT

In order to check that the subscales of the DOSPERT were related, and that the correlations were stronger within each domain, a Pearson's correlation was carried out on the subscales and domains of the DOSPERT. The correlation coefficients and associated significance levels are displayed in Appendix 3J.

To order to confirm that risk perceptions and expected benefits did predict risk behaviour in the present study; four separate hierarchical regressions were performed in the same manner as the previous study. The results of the analyses for all domains are presented in Table 3.11. For every domain, risk perception scores significantly predicted risk behaviour and the addition of the expected benefits scale significantly improved the model.

Table 3.11 Regression Coefficients for Risk Perception and Expected Benefits Scales for each Domain of Risk Behaviour

	Domain of DOSPERT									
	Social		Recreational		Financial		Health & Safety		Ethical	
	B	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
Step one		.14**		.22**		.31**		.19**		.22**
Risk perception	-.38**		-.47**		-.56**		-.44**		-.48**	
Step two		.29**		.40**		.37**		.22**		.33**
Risk perception	-.38**		-.33**		-.50**		-.42**		-.39**	
Expected benefits	.40**		.46**		.26**		.15**		.34**	

Note: * p<.05 and ** p<.01

As expected, in all analyses risk behaviour was negatively predicted by risk perception and positively predicted by expected benefits. While the addition of the expected benefits scale significantly improved the models for the social and recreational domains of risk behaviour (the proportion of variance explained approximately doubled), the change in the amount of variance explained was considerably smaller for the financial (approximately 6%) and health & safety domains (approximately 3%). For the social and recreational domains, the expected benefits scale was a stronger predictor, but for the financial, health & safety and ethical domains the risk perception scale was s stronger predictor.

As risk perceptions and expected benefits did predict risk behaviour for the participants in the present study, it was deemed appropriate to use the risk behaviour scale as the sole measure of risk-taking propensity.

The Domain Specificity of the Relationship between Risk-Taking Propensity and Warning Perception

The main aim of the study was to determine whether domain-specific measures of risk-taking propensity were related to hazard perception and intentions to comply with domain specific warnings. In order to do so four hierarchical regressions were carried on the data, one for each type of warning and dependant variable (hazard perception or intended compliance). The congruent domain of the DOSPERT was entered in the first step and all other domains were entered in the second in the same manner at the previous study. As the majority of the domains of the DOSPERT are correlated to some degree, these analyses alone do not rule out the possibility of a general factor of risk-taking propensity. In order to demonstrate that the relationship between risk-taking propensity and warning perception is domain specific beyond doubt, additional analyses were carried out where all incongruent domains were entered into a hierarchical regression in the first step and the congruent domain was added in the second. The results of these analyses are presented in Appendix 3L and none of the additional analyses contrast the results of the following analyses.

Warnings from the Health & Safety domain

Hazard perception

For health & safety warnings, the congruent domain (health & safety) of risk-taking was a significant negative predictor of hazard perception $F(1,197) = 5.214$, $p<.05$, $\Delta R^2 = .021$. The addition of the other four domains of the DOSPERT in step two did significantly improve the amount of variance explained, F change $(4,192) = 3.42$, R^2 change $=.065$, $p=.01$ and the health & safety domain became non-significant. Recreational risk-taking propensity significantly negatively predicted hazard perception of health & safety warnings, $t= -2.48$, $p<.05$, as did Ethical risk-taking propensity, $t= -2.51$, $p<.05$. High health & safety risk-taking did predict lower hazard perception to health & safety warnings, however it did not explain any more variance than the recreational and ethical domains. Table 3.12 displays the coefficients for step one and two of the analysis.

Table 3.12 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Health & Safety Warnings

	b	SE *b*	β
Step 1			
Constant	68.116	3.239	
Health & Safety	-.346	.151	-.161*
Step 2			
Constant	76.342	6.788	
Health & Safety	-.078	.174	-.036
Social	-.122	.202	-.043
Recreational	-.252	.102	-.182*
Financial	.271	.172	.116
Ethical	-.545	.217	-.205*

Note: *** p=<.001, ** p=<.01, *p=<.05

Intended compliance

For health & safety warnings, the congruent domain (health & safety) of risk-taking was a significant negative predictor of intentions to comply $F(1, 196) = 58.66$, $p<.001$, $\Delta R^2 = .23$. The addition of the other four domains of the DOSPERT improved the amount of variance explained but just missed significance, F change (4, 192) = 2.42, R^2 change =.037, p=.05. Ethical risk-taking propensity also significantly predicted intentions to comply, t= -2.27, $p<.05$. High health & safety risk-takers held lower intentions to comply with the health & safety warnings, as did high ethical risk-takers. Table 3.13 displays the coefficients for step one and two of the analysis.

Table 3.13 Regression Coefficients for Risk-taking Propensity as a Predictor of Intended Compliance to Health & Safety Warnings

	b	SE *b*	β
Step 1			
Constant	6.384	.162	
Health & Safety	-.058	.008	-.480***
Step 2			
Constant	6.538	.342	
Health & Safety	-.045	.009	-.377***
Social	.006	.010	.041
Recreational	-.005	.005	-.063
Financial	-.009	.009	-.071
Ethical	-.025	.011	-.166*

Note :*** p=<.001, ** p=<.01, *p=<.05

As expected, the congruent domain did predict warning perception and was the strongest predictor for intended compliance but unexpectedly not hazard perception. As predicted, the amount of variance explained was higher for intentions to comply than it was for hazard perception.

Warnings from the Financial Domain

Hazard perception

For financial warnings, the congruent domain of risk-taking propensity was not a significant predictor of hazard perception (p=.694). The addition of the other four domains of the DOSPERT did not significantly improve the amount of variance explained (p=.244). Only recreational risk-taking propensity significantly predicted hazard perception of financial warnings, t= -2.08, p<.05. High recreational risk-takers perceived less hazard from the financial warnings. Table 3.14 displays the coefficients for step one and two of the analysis.

Table 3.14 Regression Coefficients for Risk-taking Propensity as a Predictor of Hazard Perception to Financial Warnings

	b	SE b	β
Step 1			
Constant	50.806	3.342	
Financial	-.084	.212	-.028
Step 2			
Constant	.083	.228	.028
Financial	-.039	.267	-.011
Recreational	-.280	.134	-.158*
Social	.126	.230	.046
Health & Safety	-.258	.287	-.076
Ethical	.083	.228	.028

Note: *** p=<.001, ** p=<.01, *p=<.05

Intended compliance

For financial warnings, the congruent domain of risk-taking was a significant predictor of intentions to comply $F(1, 196) = 9.2$, p<.01, $\Delta R^2 = .04$. The addition of the other four domains of the DOSPERT improved the amount of variance explained but just missed significance (F change (4, 192) =2.29, R^2 change =.04, p=.061). Ethical risk-taking propensity also significantly predicted intentions to comply, t= -2.35, p<.05. High financial risk-takers held lower intentions to comply with financial warnings as did high ethical risk-takers. Table 3.15 displays the coefficients for step one and two of the analysis. Unexpectedly the congruent domain did not predict hazard perception and was not was the strongest predictor for intended compliance.

Table 3.15 Regression Coefficients for Risk-taking Propensity as a Predictor of Intended Compliance to Financial Warnings

	b	SE b	β
Step 1			
Constant	5.346	.185	
Financial	-.036	.012	-.212**
Step 2			
Constant	5.432	.491	
Financial	-.027	.012	-.158*
Recreational	.014	.015	.071
Social	-.006	.007	-.065
Health & Safety	.001	.013	.004
Ethical	-.037	.016	-.193*

Note: *** p=<.001, ** p=<.01, *p=<.05

Generalisability of Observed Relationships

To ensure the observed relationships are generalisable to behaviours other than those depicted in the DOSPERT, hazard perception and intended compliance to item-relevant and irrelevant warnings was correlated with the five domains for each subscale in the same manner as Study 2. The results of the analysis are presented separately for each of the three DOSPERT scales. Table 3.16 displays the correlation coefficients for the risk behaviour scale.

Table 3.16 Correlation Coefficients for Item-Relevant and Irrelevant Warnings Perception and the Five Domains of the DOSPERT Risk Behaviour Scale

		Domain				
Warning Domain	Item-relevance	Social	Recreation	Financial	Health & Safety	Ethical
Hazard Perception						
Health & Safety	Item-relevant	-.08	-.16*	-.02	-.23**	-.23**
	Item-irrelevant	-.05	-.21**	.01	-.07	-.18*
Financial	Item-relevant	-.02	-.17*	-.04	-.02	-.06
	Item-irrelevant	-.05	-.13	-.01	-.02	-.08
Intended Compliance						
Health & Safety	Item-relevant	-.05	-.10	-.23**	-.38**	-.39*
	Item-irrelevant	-.05	-.21**	-.11	-.30**	-.30**
Financial	Item-relevant	.02	-.14	-.23**	-.21**	-.21**
	Item-irrelevant	.02	-.10	-.17*	-.25**	-.25**

Note: * p<.05 and ** p<.01

Unexpectedly, risk-taking propensity in the financial domain was not related to hazard perception for either item-relevant or irrelevant congruent warnings. Risk-taking propensity in the health & safety domain was negatively related to hazard perception for item-relevant congruent warnings only. Risk-taking propensity in the financial domain was negatively related to intended compliance for both item-relevant and irrelevant congruent warnings. Risk-taking propensity in the health & safety domain was negatively related to intended compliance for both item-relevant and item-irrelevant congruent warnings. The correlation between risk-taking propensity and intended compliance to congruent item-irrelevant warnings was stronger and more significant for the health & safety domain. Although risk-taking in some domains was related to perceptions of warnings from incongruent domains, the correlations highlighted in bold in Table 3.16 show that contrary to predictions, the relationships were not always strongest within domain.

These results suggest that the observed relationships found between risk-taking propensity and warning perception may be not be considered externally valid for hazard perceptions and as such may be treated with caution. However the relationships may be considered valid for intended compliance, therefore they may be applied to a range of risky behaviours and are not limited to those prescribed in the DOSPERT.

3.3.3. Study Three Discussion

Overall the results of the present study replicate the results of Study Two to some extent, in that at least one domain of risk-taking propensity was found to predict negatively warning perceptions to both types of warning. However, the results of the present study were not as clear cut as the previous. The main prediction of the present study, that the relationship between risk-taking propensity and warning perception would be domain specific was supported to a lesser certain extent than the previous study. Health & safety risk-taking propensity did predict health & safety hazard perception but was not the strongest predictor. As expected health & safety risk-taking propensity was the strongest predictor of intentions to comply with health & safety warnings. For financial warnings, financial risk-taking propensity was not a significant predictor of hazard perception and although it was a significant predictor of intended compliance to financial warnings, it was not the strongest predictor.

Inspection of the correlations between scores on the domains of the DOSPERT and responses to item-relevant and irrelevant warnings suggest the observed relationships apply to both types of warning for intentions to comply but not for hazard perception. For intended compliance only, the effects may not be considered a product of the design of the study and should extend to other behaviours within the same domain. For hazard perception however the results may not hold external validity and should be treated with caution.

Consistent with predictions (and the results of Study Two) risk-taking propensity predicted intentions to comply more strongly than hazard perception. For health & safety warnings, the amount of variance explained was larger for the relationship between risk-taking propensity and intentions to comply than for the relationship between risk-taking propensity and hazard perception. For financial warnings, the model did not significantly predict hazard perceptions whereas it did predict intentions to comply. Again, this is comparable with the findings of Study One, suggesting that a person’s individual likelihood of engaging in risky behaviours influences their intentions to comply with warnings, more than their perceptions of the hazard implied by warnings.

While the congruent domain was not always the strongest predictor of warning perceptions, most incongruent domains were unrelated to warning perceptions, thus demonstrating a degree of domain specificity. Where incongruent domains were related to warning perceptions, it was found that the ethical domain was related to intentions to comply with both types of warnings but only to hazard perceptions of health & safety warnings. This is comparable to the results of study one which found the ethical domain was related to hazard perception of recreational and health & safety warnings. Other incongruent relationships were found between recreational risk-taking propensity to hazard perceptions of both financial and health & safety of warnings but not to intentions to comply with either.

When the risk perception and expected benefits scale of the DOSPERT was regressed against the risk behaviour scale for each domain, the addition of the expected benefits scale increased the amount of variance in risk behaviour explained by a considerable amount compared with that explained by risk perceptions alone, and was a stronger predictor of risky behaviour for the social and recreational domain. Similarly to Study Two, the amount of variance explained increased by a much smaller extent and the expected benefits scale was a stronger predictor for the health & safety domain (again approximately 3%). Contrary to Study Two this pattern was also observed for the financial domain (variance increased by approximately 6%). Although the amount of variance explained for the ethical domain increased to a larger extent with the addition of the expected benefits, the risk perception scale was also a stronger predictor. This suggests that the expected benefits of the behaviours are more influential for social and recreational risks for risky behaviour. However, risk perceptions are more influential for the health & safety, financial and ethical domains respectively.

As previously noted, the results of the previous study indicate that the relationship between risk-taking propensity and warning perception is domain specific, at least for intentions to comply with health & safety warnings. Contrary to predictions, this was not the case for financial warnings. These unexpected findings may be explained by methodological issues, in particular the homogeneity of the sample used, the implications of which are explored further in the general discussion.

3.4. General Discussion

The findings of the studies presented within this chapter replicate the findings of Study One, in that for each analysis at least one domain of risk-taking propensity significantly predicted warning perceptions, and high risk-takers on those scales gave lower hazard perceptions and intentions to comply with the warnings. This provides more support for the recognition of risk-taking propensity as an individual difference in warning perception. As expected, the effect sizes yielded within the present studies were larger than those observed in Study One. This suggests that while risk-taking propensity is related to warning perceptions of simple warnings, the relationship is stronger when specific information about a particular hazard is provided. This is consistent with the notion that individual's beliefs and expectations of a hazardous situation have a larger influence over behaviour than the warning itself (e.g. DeJoy, 1991).

It also appears that the relationship between domain specific measures of risk-taking propensity is stronger for intentions to comply than hazard perception of the warnings. The amount of variance explained was larger for intended compliance than for hazard perception across all warning types. This is comparable with the findings of Study One where more measures of risk-taking propensity were related to intentions to comply than hazard perception of the simple auditory and visual warnings. Again this supports the view that risk-taking propensity has a larger effect over intentions to comply with a warning than the perception of the level of hazard implied by the warning.

It may be the case that high risk-takers do not perceive any difference in hazard from the warnings but are less likely to comply with them because of situational factors which affect the utility judgement. It may be the case that high risk-takers evaluate the level of hazard from the warnings correctly but hold larger evaluations of the benefits of the behaviours. It is possible, high risk-takers choose to accept risks rather than perceive them incorrectly.

The studies presented in this chapter provide support for the prediction that the relationship between risk-taking and warning perception is domain specific to a certain extent, in particular, for intentions to comply with the warnings. For hazard perception, the congruent domain was the strongest predictor for both types of warning in Study Two, and health & safety warnings in Study Three. The congruent domain of risk-taking propensity was the strongest predictor of intentions to comply with all warnings with the exception of the financial warnings in Study Three. This suggests that an individual who is a high risk-taker in one domain is likely to hold low intentions to comply with warnings from that domain but may not necessarily hold lower intentions to comply with a warning from another domain. For example, a person with a high likelihood of health & safety risk-taking may be more likely to decide not to comply with a health & safety warning than a warning from another domain of risk, e.g. financial.

The health & safety domain of risk was also related to hazard perception and intended compliance to recreational warnings and vice versa. As previously discussed, the negative consequences of risk from both these domains may be similar; however, the positive consequences or benefits are quite different. There appear to be fewer benefits to health & safety risks, indeed the expected benefits scale offered less prediction of variance in behavioural likelihood compared to the other domains. Therefore there may be something conceptually different about health & safety risk-takers compared to risk-takers in other domains. For example they may have lower hazard perception and intentions to comply toward warnings in *general*, possibly resulting from an underestimation of negative consequences or a tolerance to fear of such consequences. Alternatively health & safety risk-takers may also attribute higher benefits to the health & safety behaviours. Whatever the case it is clear such people are especially in need of effective warnings.

Unexpectedly, the ethical domain of risk-taking propensity was related to hazard perception of warning from both domains in Study Two and hazard perception and intended compliance to health & safety warnings as well as intentions to comply with financial warnings in Study Three. One explanation for this may be that there are potential similarities between the domains of health & safety and ethical risks. Although the consequences of health & safety and ethical risk-taking may differ (health & safety is most likely to result in external physical consequences e.g. injury/death and ethical is most likely to result in more internalised consequences e.g. guilt, social exclusion) they do share a common factor. Both domains are related to how a person should behave in society, for example drink driving may be far less socially acceptable than a recreational risk with similar probability and severity of consequences. Indeed Weber et al. (2002) found that both the health & safety and the ethical domains were related to the impression management scale of the Paulhus (1984) social desirability scale, while the remaining domains were unrelated to this scale. People who are low risk-takers in these two domains may be partially driven by the need to present themselves in a socially desirable way (e.g. as 'good' people). Weber also argues that social desirability may lead to lower risk-taking 'in order to protect one's self-image' (2002, p. 278). This is relevant to warning perception as low ethical risk-takers who want to appear as 'good' citizens may (a) be biased to give responses which suggest that they are compliant or (b) actually be more compliant as they see themselves as 'good' people and want others to see them in the same way. Conversely, it could be that higher risk-takers in these domains have less regard for how people see them, and perhaps less regard for themselves (and others) in general (hence why they take physical and ethical risks).

An unexpected finding was that financial risk-taking propensity did not predict hazard perception to financial warnings and was not a strong predictor of intentions to comply with them. This finding may be explained by methodological limitations. One issue is that the sample recruited for Study Three was more homogenous than that implemented in Study Two Due to practical constraints only undergraduate psychology students were recruited for Study 3 whereas the online recruitment in Study Two allowed a more representative sample to be obtained. This poses a particular threat to validity here as the younger undergraduate community may not fully understand or appreciate the financial risks and may be less like to consider such financial issues than the wider population. Also this population is likely to have an income primarily based of student loans, perhaps skewing the responses the items which quantify amounts of money gambled/invested in terms of wages e.g. 'Betting a day's income at the horse races'. They are likely to be less familiar and even less interested in financial risks. It may be the case however, that such participants may be more familiar with and may have a better understanding of gambling risks compared to investment. Also the sample selected for the main study of Study Three differed from the sample in the pilot study, whereas in Study two both the pilot study and the main study used participants from a wide demographic range. Thus meaning that the pre-rated behaviours may have not been accurate for the population obtained in the main study. Similarly, the primarily student sample in Study Three may have affected the results in that such people may seek lower risk from health & safety behaviours compared to the general population. Young people may be less concerned with physical risks as they are less likely to have responsibilities and dependants. Getting injured may be more costly to a worker if it means they will lose out on wages and struggle to care for dependants.

Another issue arising from the use of financial warnings may be that during the pilot study, the participants rated the financial behaviours from the DOSPERT as less risky than the health & safety behaviours. When constructing the DOSPERT, Weber et al (2002) concentrated on the factors upon which each item loaded but did not consider their relative risk levels. While this is a valid approach to ensure that each item has high construct validity, the resulting factors (domains) are not equal in terms of their relative (or actual) risk levels. Indeed Blais and Weber's (2006) finding that there is considerably greater variation within participants (across domains) than there is between participants could be partially due to the fact that the domains vary greatly in their actual risk level to begin with. It may be the case that individuals appear to be lower in health & safety risk-taking than recreational. However, it is not clear whether this is because they actually take fewer risks in this domain or that the behaviours featured in the health & safety scale are actually more risky than for the recreational domain. Therefore, the DOSPERT may be appropriate for predicting risk attitudes within a particular domain and determining if one individual is a higher risk-taker within a domain compared to another individual. However, it cannot reveal reliably whether an individual is actually higher in risk-taking propensity in one domain than another, and attempts to do so may be treated with caution.

Despite the attempts of the pilot study to select behaviours that were approximately equal in terms of relative risk across domain, the results of Study Three revealed that participants did perceive the health & safety warnings to convey more hazard than the financial ones. This also led to inconsistencies in the relative risk levels of the behaviours across study two and three. For example in study two the behaviour 'Driving a car without a seat belt' was selected as a medium hazard warning context whereas the same behaviour in Study Three was categorised selected as a context for a high hazard warning.

Another limitation of the use of the DOSPERT is that the scale may not translate accurately to a UK population. As the scale was designed for an American population, many of the behaviours do not pose the same risks as in the UK, for example 'going camping in the wilderness' in the USA is more risky as there are more dangerous wild animals than in the UK. This was a particular problem for the financial risks, as many of the investment items referred to American systems. However, attempts were made to minimise the implications of this in Study Three by modifying the items.

Despite these problems, it is clear that risk-taking propensity is related to warning perceptions and that this relationship is domain specific to a certain extent. It is clear that there are differences between high and low risk-takers in terms of their intentions to comply with warnings. However, it is not possible from the results of the present studies to determine the theoretical underpinnings of this relationship. Therefore, the study presented in the following chapter aimed to explore the psychological mechanisms behind this relationship.

Chapter Four

Study Four: Exploring the Potential Underlying Mechanisms behind the Relationship between Risk-Taking Propensity and Warning Perception

4.1 Introduction

The studies presented so far establish a clear relationship between a variety of risk-taking propensity measures and warning perception (in particular intentions to comply with warnings). The previous study demonstrated that the relationship is stronger when contextual information is provided, and that the relationship is domain specific. It is less clear what psychological mechanisms underlie this relationship. Elucidating the underpinnings of this relationship is essential to improve compliance in high risk-takers. The present study aims to identify potential factors which may mediate the effect risk-taking propensity has on warning perceptions.

As risk-seekers and risk-avoiders are thought to differ in their evaluations of risks and potential outcomes, these evaluations may impact upon the decision to comply with a warning. Risk-taking propensity affects perceptions of the probability and magnitude/value of potential outcomes (both positive and negative), and as high risk-taking propensity correlates with low intentions to comply, it seems likely that risk-takers' decisions may be driven by such perceptions.

As discussed in Chapter One, rational choice models of risky decision making fail to explain real world decisions where all possible alternatives and their probabilities are seldom known and decision makers are short of time and resources (Simon, 1982). Heuristics are employed to reduce processing and speed up decisions, however they can lead to biases (e.g. Kahneman et al., 1982). Some common heuristics are outlined in Chapter One, and two of those in particular have received attention as possible underlying mechanisms of risk perceptions; the availability heuristic and the simulation heuristic (Greening, 1997). The availability heuristic refers to the ease with which instances of an event are recalled and can bias probability judgements whereas the simulation heuristic refers to the ease with which scenarios and outcomes can be mentally simulated or imagined. The availability heuristic may be illustrated by the fact that people overestimate the probability of death by homicide as it is frequently reported in the media and is therefore more available in memory (Lichtenstein et al., 1978). Kahneman and Tversky (1982) illustrated the simulation heuristic with the example of a risky adventurous expedition. If one imagines all the situations for which the expedition is ill equipped then it will appear very risky, alternately if some of those situations are difficult to imagine (regardless of their actual probability) then the expedition will be perceived as relatively low risk. Although both the simulation and availability heuristics have been associated with risk perception, the simulation heuristic has been found to be more influential (Greening, Dollinger, & Pitz, 1996; Heath, Acklin, & Wiley, 1991). The simulation heuristic has been found to influence perceptions of health-related risks (Heath et al., 1991; Sherman, Cialdini, Schwartzman, & Reynolds, 1985). Greening and colleagues also found evidence that mental simulation partially mediated the relationship between personal experience and risk perception of natural disasters (Greening et al., 1996) as well as accidents at work (Greening, 1997).

When deciding to comply with warnings individuals may imagine or mentally simulate possible outcomes of their decisions (which may or may not reflect actual risks). It is possible that risk-taking propensity is related to the way in which outcomes are imagined or simulated, and this may underlie the previously observed relationship between risk-taking propensity and warning perception.

Mental simulations can be generated about the past or the future, it is possible to imagine how a decision already made could have resulted in a better or worse outcome just as it is possible to imagine how a present decision may result in a positive or negative outcome. Counterfactual or retrospective simulation is the imagination of alternative outcomes to an event that has already happened and are characterised by 'what if' thinking (Byrne, 2005;

Kahneman & Miller, 1986). Prospective or prefactual simulations on the other hand are alternative predictions made before the actual outcome is known, characterised by 'what may be' thinking (Sanna, 1996). Although counterfactual thinking is thought to influence behaviour (Sanna, Carter, & Small, 2006), prefactual thinking involves the consideration of potential future outcomes, therefore it may be directly related to decision making, including the decision to interact with a hazard in a compliant manner. It could be argued that warnings are intended to stimulate prefactual thinking by explicitly outlining the negative consequences of non-compliance.

There is a wealth of research into counterfactual thinking (retrospective simulation) for example how and why such simulations occur (e.g. Roese, 1997; Sanna et al., 2006), by whom (Kasimatis & Wells, 1995), and how they influence personal well-being (e.g. Sanna, 1999; 2000). There is much less research into prefactual thinking however, Sanna, Carter and Small (2006) proposed an integrated model to explain how such imaginations affect people's thoughts, feelings and decision over time. The model TEMPO (Time, Environment, Motivation, Personality, and Outcome) organises factors which affect mental simulation (both retrospective (counterfactual) and prospective (prefactual). They argued that these mental simulations are conceptually related despite being investigated by independent literatures. Therefore it is possible that findings from research into counterfactual thinking may be extended to prefactual thinking.

Although it is possible to prime participants to adopt a counterfactual mind set in which alternative realities are more accessible in order to influence subsequent decisions and behaviours (e.g. Galinsky & Moskowitz, 2000), there is evidence of individual differences in the extent to which simulations are generated spontaneously (Gomez Beldarrain, Garcia-Monco, Astigarraga, Gonzalez, & Grafman, 2005). Individual differences in the ability to think in a counterfactual manner have been measured by the counterfactual inference test (Hooker, Roese, & Park, 2000). The test presents participants with short scenarios about two different characters who experience similar events and asks participants which person would think about what just happened to them the most. The items are based on factors which have been found to increase counterfactual thinking such as near misses (e.g. 'Jack misses his train by 5 minutes. Ed misses his train by more than an hour. Who spends more time thinking about the missed train?'). However such tests do not capture the spontaneous nature of mental simulations in specific scenarios relevant to the individual. Other methods for measuring individual differences in mental simulations involve explicitly asking people to describe alternatives in open-ended questions (e.g. Goerke, Möller, Schulz-Hardt, Napiersky, & Frey, 2004; Roese & Olson, 1997; Sanna, 1996; Sanna & Turley, 1996). Again this method may not accurately capture variations in spontaneous mental simulations as participants may be primed by the instructions.

Spontaneous mental simulation, on the other hand, has been measured using scenario-based tasks which ask participants to write down their thoughts on the given scenario. Their responses are then coded for the number of counterfactual (or prefactual) statements included (e.g. McConnell et al., 2000; McEleney & Byrne, 2006). The instructions are kept vague in an attempt not to prime participants to respond in a certain way and may capture the spontaneous nature of mental simulation more accurately. Indeed, Kasimatis and Wells (1995) argued that all individuals are able to generate mental simulations when prompted but some spontaneously generate more simulations than others. Gomez Beldarrain et al (2005) found that simulations were impaired in patients with prefrontal cortex lesions when self-generated but not when responding to counterfactual cues.

While there are differences in the extent to which individuals engage in mental simulation, there are also individual differences in the direction or valence of the simulations generated. Some individuals are prone to upwards simulations (imagining the situation with a better outcome) and some to downwards simulations (imagining the situation with a worse outcome). Differences in the direction of counterfactuals (and prefactuals) generated have been found to be related to the traits optimism and pessimism (Sanna, 1996). Other constructs related to counterfactual thinking include conscientiousness (Gomez Beldarrain et al., 2005), desire for control and 'belief in a just world' (see Kasimatis & Wells, 1995 for a review). Sanna et al. (2006) suggested that mental simulations may underlie other personality traits and motivations. It is therefore possible that differences in the way people prospectively simulate outcomes may be related to personality and construct measures of risk-taking like the ones implemented throughout this thesis. If one imagines that the outcome of a risky behaviour will be positive they may be more likely to engage in it, whereas if one imagines the same situation resulting negatively they may be less likely to engage in the same behaviour. As the previous studies have shown that high risk propensity is related to lower intentions to comply with warnings, it may be the case that this relationship is mediated by prefactual thinking. For example, when high risk-takers are faced with a warning, they may be less likely to simulate negative prefactuals (or more likely to simulate positive prefactuals).

Studies have found than when participants are encouraged to simulate prospectively negative outcomes their intentions to undertake risky behaviour are decreased. Boninger, Gleicher, Hetts and Moore (see Gleicher et al., 1995) found that getting participants to imagine contracting HIV from not using a condom increased positive attitude to condom use compared with control groups who received facts about HIV transmission. Similarly Richard, Van der Plight and de Vries (1996) found more participants reported that they would regret sleeping with a partner without a condom when they were asked to consider how they would feel *afterwards* compared with participants who were asked to simply consider their feelings *about* having sex without a condom. Follow-up studies suggest participants under this condition also gave higher expectations to use condoms in future and reported more frequent actual condom use.

As suggested by the latter study, regret is an important factor in the way that mental simulations influence behaviour. Zeelenberg, Nielsen, Breugelmans and Pieters (2008) argued for the influence of emotion on decision-making and that "emotions exist for the sake of behavioural guidance" (Zeelenberg & Pieters, 2006, p. 211). Regret has been found to be relevant to decision making (e.g. Bell, 1982; Loomes & Sugden, 1982) and it is likely to be relevant to warning compliance. Non-compliance is essentially a decision which one may potentially regret.

In order to experience regret one must be able to imagine possible states of the world which differ from the current state. That is, one must imagine how the outcome of a decision (the present reality) might have been different if a different decision had been made in the past (Zeelenberg & Pieters, 2006) and as such it is related to counterfactual thinking (Sanna et al., 2006). This definition implies that regret is a product of counterfactual thinking.

Regret is aversive and motivates individuals to make decisions which will result in minimal regret. For regret to influence future decisions (i.e. the decision to comply with a warning or not), it must be anticipated, although there is some disagreement as to whether or not anticipated regret is a 'true' emotion (Frijda, 2004; Zeelenberg & Pieters, 2006). Prefactual thinking can bring about anticipated regret which influences attitudes and future behaviours (Gleicher et al., 1995). Priming prefactual thinking in participants through anticipated regret has been shown to affect behaviour. Hetts, Boninger, Armor, Gliecher and Nathanson (2000) asked participants to complete a simulation game, in which they were offered the opportunity to purchase insurance to protect a 'treasure' (an amount of money which they would actually receive at the end of the game). Participants purchased more insurance if they were informed that if they did not use the insurance they would regret spending on it compared with participants who were informed that they would regret not purchasing the insurance if they lost the money.

If a person imagines that their behaviour will result in negative consequences, they will anticipate feeling regret and be less inclined to carry out the behaviour. Therefore, individuals who readily generate negative prefactuals may make risk-averse decisions whereas those who readily simulate positive outcomes may make risk-seeking decisions. Decision-making studies have shown that anticipated regret accounts for deviations from decisions that maximise utility (Camille et al., 2004; Coricelli, Dolan, & Sirigu, 2007).

Traditionally, regret aversion has been linked to risk aversion, however this is not necessarily the case. It appears that anticipated regret can lead to risk-seeking or risk avoidance depending on the context (Zeelenberg, Beattie, van der Pligt, & de Vries, 1996; Zeelenberg & Pieters, 2004). If a person anticipates regret from *not* engaging in a risky behaviour they will be less motivated to refrain from that behaviour. For example an adolescent who is offered illegal drugs by their friends may anticipate regret from missing out on a fun time and will be motivated to take the risk.

There are individual differences in the way that people experience regret, for example, people with orbitofrontal cortex damage experience diminished regret and mental simulation (e.g. Camille et al., 2004). Regularity focus has also been linked with prefactual thinking and anticipated regret. Regulatory Focus Theory (Higgins, 1998) proposes that there are two distinct motivational systems; promotion (associated with sensitivity to gains) and prevention (associated with sensitivity to losses). The influence of these two systems can vary in terms of situational factors and dispositional factors. Zhu, Tu, Lin and Tu, (2009) studied the role of prefactual thinking and disposition on unplanned purchase intentions and found that anticipated regret was more influential for prevention-focused individuals whereas anticipated rejoice was more influential for promotion focused individuals. Regularity focus has been closely associated with Carver and White's (1994) behavioural inhibition and behavioural activation systems (Cunningham, Raye, & Johnson, 2005). Regularity focus, however is thought to be a "higher order motivational state that directs focus of attention and evaluation, which in turn directs behaviour, including approach and avoidance behaviour" (Cunningham et al., 2005, p. 203). This close association suggests that behavioural inhibition may relate to prefactual thinking styles and anticipated regret.

The construct 'consideration of future consequences' (CFC; Strathman, Gleicher, Boninger, & Edwards, 1994) is also associated with differences in the extent to which people experience regret. The CFC scale measures "individual differences in the extent to which people consider the immediate versus distant implications of current actions and outcomes" (Gleicher et al., 1995, p. 285). High scorers are concerned with the distant future implications of their decisions, whereas low scorers 'live for the moment' and forsake long term goals for immediate and short term gratification.

An individual's tendency to consider future consequences has been found to moderate the affective responses to counterfactual thinking. Boninger, Gleicher, and Strathman (1994) found that when counterfactually imagining how a situation could have been improved with implications for future scenarios, participants with high CFC scores experienced less regret compared with low scorers as they appreciated that they can 'learn from their mistakes' and improve similar future situations. Scores on the CFC scale also predict engagement in risky behaviours. Strathman, et al. (1994) found individuals low in consideration of future consequences engaged in more cigarette and alcohol use. Similarly they were more likely to engage in risky sex and less likely to get tested for HIV (Dorr, Krueckeberg, Strathman, & Wood, 1999). It has been shown that CFC scores correlate negatively with sensation seeking (Joireman, Anderson, & Strathman, 2003). Indeed high sensation seekers (and high risk-takers in general) may forego long term benefits of not engaging in risk behaviours for their immediate gratification.

The relationships discussed suggest that prefactual thinking, anticipated regret, and consideration of future consequences may mediate the relationship between risk-taking propensity and warning perception. Kalsher & Williams (2006) have suggested that prefactual thinking may be relevant to warnings and risk communications. They argue that increasing prefactual negative outcomes and anticipated regret is likely to produce greater compliance to warnings. Unpublished data has found that fear appeals for meningitis vaccination and sunscreen use produced more behavioural compliance when "prefactual emotions of regret, guilt and challenge" were included (see Kalsher & Williams, 2006, p. 324). Also Crawford, McConnell, Lewis and Sherman (2002) found compliance with a persuasive message from a confederate in a gambling task was higher when participants were asked to consider the regret they would feel if they did not comply.

Given the potential relationships between prefactual thinking, anticipated regret, and risky decision making, it is plausible that high risk-takers may spontaneously generate fewer negative outcomes and/or more positive outcomes than low risk-takers when faced with a hazard. As they may perceive less risk and/or more benefits, they may in turn experience lower levels of anticipated regret when faced with the decision to comply with a warning. Risk seekers have been found to focus more on potential positive consequences of risky behaviour and risk avoiders on negative (Cloninger, 1987; Horvath & Zuckerman, 1993; Steketee & Frost, 1994) and this may be driven by the way they simulate future consequences.

The main aim of the present study was to examine whether prefactual thinking, anticipated regret, and consideration of future consequences underpin the relationship between measures of risk propensity and intentions to comply with warnings. Participants were presented with contextual warnings similar to those implemented in Studies Two and Three. Intended compliance was the main dependant variable (hazard perception was also measured; however, the previous studies have shown that risk-taking propensity is a better predictor of intended compliance than hazard perception). Sensation seeking and behavioural inhibition were chosen as the measures of risk-taking propensity in the present study for two reasons: firstly they were both related to intended compliance in Study One; second, sensation seeking correlates with CFC scores (Joireman et al., 2003) and BIS is very similar to prevention focus which correlates with anticipated regret (Zhu et al., 2009). Prefactual thinking, anticipated regret, and CFC scores were potential mediator variables. Spontaneous prefactual thinking (both positive and negative outcomes) and anticipated regret were measured in relation to each warning stimulus.

It was predicted that the present study would replicate the findings of the previous studies in that risk-taking propensity would predict intended compliance. It was also expected that risk-taking propensity would correlate with the mediator variables. High risk-takers were expected to report more positive outcomes and fewer negative outcomes than low risk-takers. High risk-takers were also expected to anticipate less regret from non-compliance than low risk-takers. Risk-taking propensity was expected to correlate negatively with CFC scores. Additionally the mediator variables were expected to relate to the dependant variable. Positive prefactual thinking was expected to correlate negatively with intended compliance whereas negative prefactual thinking was expected to relate positively. Anticipated regret and CFC scores were expected to correlate positively with intentions to comply. It was also predicted that at least one of the potential mediator variables (prefactual thinking, anticipated regret or CFC scores) would mediate the relationship between risk-taking propensity and intentions to comply.

4.2 Method

4.2.1 Participants

One hundred and fifty six undergraduate students participated in the study for course credit. Of these 41 were male and 115 were female and participants' ages ranged between 18 and 47 years (M=21.14, SD= 4.56). No other demographic information was recorded.

4.2.2 Materials

The warning task was a computer program which presented participants with 15 visual warning labels (12 experimental warnings and three practice trials where no recorded). In the same manner as the warning tasks used in the previous studies, the warnings were randomly presented one at a time. Participants were asked to give four responses for each one; a measure of hazard perception, intended compliance, anticipated regret and a prefactual measure.

The warning stimuli were in the form of warning labels similar to those used in Studies Two and Three. The labels consisted of 15 cm x 10 cm rectangles with a 3.5cm x 15cm header above a 6.5cm x 15 cm message box. The label outlines were black and had a width of 15pts. The header contained a pictorial and signal word (DANGER) in white against a red (r:225, g:0, b:0, o:225) background. The pictorial consisted of a triangle containing a red exclamation mark. The exclamation mark and the signal word were typed in capitals in Arial Black (Bold) font with the former at 48pts and the latter at 65pts.

The font for the message section of the warning was Helvetica (Bold) in font size 26. The message included a statement about the nature of the hazard, and instructions for mitigating the consequences of the hazard. A statement about the consequences of not following the warning was excluded from this information as it could potentially prime participants to generate prefactual outcomes. The statements were definitive in tone (e.g. riding a motorcycle without a helmet *is* dangerous). The individual contextual information for each warning was taken from a bank of behavioural contexts previously pre-rated on a scale of 1-10 for their relative risk levels (see Study Two pilot, Chapter Three; n= 39). Half of the behaviours fell under the health & safety domain and half under the recreational domain in order to avoid homogeneity which may restrict the applicability of potential findings to one domain of risk. The behaviours were selected so that approximately half were above the median risk rating and half below to achieve a range of relative risk levels. The behaviours featured in the practice stimuli were chosen to represent high medium and low risk. As in the previous studies, they consisted of the highest rated behaviour, the lowest and one from the median risk rating to calibrate participants' responses appropriately. The behavioural contexts and their relative risk ratings are presented in Table 4.1 and the warning stimuli are displayed in Appendix 4A. Participants' hazard perception and intentions to comply were measured in the same manner as previous studies.

Table 4.1 The behaviours used as warnings stimuli context and their prejudged relative risk levels

Behavioural Context	Risk Rating (m)
Practice stimuli	
Running a red light at a train crossing	9.18
Engaging in unprotected sex	6.85
Going camping in the wilderness	3.53
Health & Safety	
Driving under the influence of alcohol	8.9
Riding a motorcycle without a helmet	8.33
Inserting a metal object into a toaster whilst in use	7.88
Crossing a dual carriageway without using a pedestrian crossing	6.75
Sunbathing without sunscreen	6.15
Drinking more than the recommended units of alcohol a week	4.35
Recreation	
Going down a ski run that is beyond your ability	7.45
Rock climbing without a harness	7.4
Mountain climbing in unknown weather conditions	7.25
Taking an inflatable out to sea	6.6
Paragliding on a rainy day	5.63
Swimming at a beach not manned by life guards	4.63

Anticipated regret was measured by presenting the participants with a statement similar to that used by Abraham and Sheeran (2004). Participants were asked to indicate the extent to which they agreed on a 7 point Likert-type scale (in keeping with the intended compliance measure) ranging from 'definitely agree' to 'definitely disagree'. The statements varied according to the warning context, however the structure remained the same, for example '**If I** *did not wear a helmet while riding a motorcycle* **I would feel regret**'. See Appendix 4B for the anticipated regret statements.

Spontaneous prefactual thinking was measured by an open-ended question. For each warning participants were asked to list the relevant thoughts that would go through their minds when deciding whether or not to comply with this warning. The wording for this measure was purposely vague so as not to direct responses in any way thus ensuring that any prefactual thoughts generated should be spontaneous in nature. A similar methodology has been employed in previous mental simulation research (e.g. McConnell et al., 2000; McEleney & Byrne, 2006). Participants typed responses into an unlimited text box and were not given a time limit, though they were advised to take no longer than 2 minutes. See Appendix 4C for screen shots from the warning task displaying the anticipated regret and prefactual measure as well as the instructions for this task.

Two judges independently examined the participants' responses to the prefactual measure, using a coding scheme (see Appendix 4D). Prefactual thoughts were defined as '*Sentences that give evidence that the individual is speculating specific future outcomes of following/not following the warning*'. The number of prefactual outcomes present in each participant's response to each of the 12 warnings was recorded in keeping with previous research (McEleney & Byrne, 2006). McConnell et al. (2000) took a slightly different approach; they only judged the first line of participants' responses. They argue that participants' first response is the most salient in their minds and therefore of most importance. For the present study it was felt that this approach may exclude other important responses, it may not be the case that people are only influenced by their first thought and may consider other possibilities which may affect their intentions to comply. For this reason, and to allow for a greater variation, all of the participants' responses were considered in the coding process. The prefactual outcomes were coded for their direction (positive or negative) separately. Initial inter-judge agreement was 87% for negative outcomes and 95% for positive outcomes. Discrepancies were resolved by discussion as used by McEleney and Byrne.

Sensation seeking was measured using the Sensation Seeking Scale Form V (SSS-V; Zuckerman, 1994) and is presented in Appendix 2D. Behavioural Inhibition (BIS) and Behavioural Activation (BAS) were measured using the BIS/BAS scale (Carver & White, 1994) presented in Appendix 2E. Responses for the BAS scale were not used in analysis but were included within that BIS/BAS scale so as not to alter the structure of the original scale.

Consideration of future consequences was measured using the CFC (Strathman et al., 1994) which can be found in Appendix 4E.

4.2.3 Procedure

Participants sat at a computer desk and completed three tasks; the warning task, the SSS-V, and the CFC and the BIS/BAS were presented together and treated as one task. The warning task and SSS-V were both presented to participants on screen, and the CFC and BIS/BAS were presented on paper. The three tasks were counterbalanced using a complete counterbalanced measures design and the order of presentation of the anticipated regret and the prefactual measure within the warning task were counterbalanced across participants to prevent order effects. Participants were verbally instructed of the order in which to complete the tasks after reading a general brief (presented in Appendix 4F).

4.3 Results

4.3.1 Descriptive statistics and reliability checks

A Pearson's correlation revealed hazard perception of the 12 warnings was correlated with intentions to comply for each of the 12 warnings (r=.62, p<.001). Reliability analyses were carried out on the data for all variables excluding the prefactual thinking measure as this was not a scale variable. The mean, standard deviation and Cronbach's alpha coefficients are presented in Table 4.2. All variables yielded moderate to high reliability (Kline, 1999).

Table 4.2 The Mean, Standard Deviation and Cronbach's Alpha for all variables

	Mean	SD	α
Hazard Perception	65.40	13.41	.87
Intended Compliance	5.38	.68	.72
CFC	3.20	.66	.86
Anticipated Regret	4.74	.82	.74
Sensation Seeking	22.51	5.28	.73
Behavioural Inhibition	21.47	3.92	.77

4.3.2 Counter balancing check

As the order of presentation of the prefactual measure and the anticipated regret measure was balanced across participants, a MANOVA was conducted to determine any order effects. The test of between subjects effects revealed that more prefactual statements were identified when the anticipated regret measure was presented first (M=2.62, SE=.34) compared to when the prefactual measure was presented first (M=1.80, SE=.07) however this difference did not reach significance, $F(1,154) = 2.96$, $p = .087$. The test also revealed that participants reported higher anticipated regret when the anticipated regret measure was presented first (M=4.87, SE=.09) compared to when the prefactual measure was presented first (M=4.62, SE=.09) however this difference narrowly missed significance, $F\ (1,154) = 3.59$, $p = .06$.

4.3.3 Prefactual thinking

Overall there were 676 negative prefactual outcomes and 99 positive prefactual outcomes identified in the participants' responses. The total number of prefactuals spontaneously generated for each warning across all participants, is displayed in Table 4.3 along with their predicted risk levels rated during the pilot study.

Table 4.3 The number of prefactual outcomes identified for each warning

Warning	Risk (m)	Prefactuals	
Health & Safety		-	+
Driving under the influence of alcohol	8.9	120	1
Riding a motorcycle without a helmet	8.33	75	2
Inserting a metal object into a toaster whilst in use	7.88	63	2
Crossing a dual carriageway without using a pedestrian crossing	6.15	37	5
Sunbathing without sunscreen	6.75	73	17
Drinking more than the recommended units of alcohol a week	4.35	17	16
Recreation			
Going down a ski run that is beyond your ability	7.45	36	29
Rock climbing without a harness	7.4	57	3
Mountain climbing in unknown weather conditions	7.25	85	5
Taking an inflatable out to sea	6.6	47	14
Swimming at a beach not manned by life guards	4.63	23	3
Paragliding on a rainy day	5.63	43	2

4.3.4 Relationships between predictor and mediator variables

The inter-relationships between the risk measures (sensation seeking and behavioural inhibition) and potential mediator variables (anticipated regret, prefactual thinking and CFC scores) were calculated using Pearson's correlation. The correlation coefficients are displayed in Table 4.4.

Table 4.4 The inter-correlations between the potential predictor variables of warning perception

	(1)	(2)	(3)	(4)	(5)	(6)
CFC (1)	-					
Anticipated Regret (2)	.213**	-				
Positive Outcomes (3)	-.028	-.243**	-			
Negative Outcomes (4)	.174*	.158*	.103	-		
Sensation Seeking (5)	-.195*	-.372**	.333**	-.049	-	
Behavioural Inhibition (6)	.229**	.285**	-.178*	.157	-.379**	-

Note: * p<.05 and ** p<.01

Mediator Variables

The CFC scores correlated with anticipated regret and the number of negative outcomes generated but not the number of positive. Anticipated regret correlated with both positive and negative outcomes. The simulations of positive consequences correlated negatively with anticipated regret and the simulation of negative consequences correlated positively with anticipated regret. This relationship was stronger for positive outcomes than negative outcomes.

Risk Measures

Scores on the CFC scale correlated with both risk measures (sensation seeking and behavioural inhibition). The relationship was stronger for behavioural inhibition than for sensation seeking. The scale also correlated with anticipated regret and negative outcomes but not positive outcomes. Sensation seeking correlated strongly and negatively with anticipated regret whereas BIS scores correlated strongly and positively with anticipated regret.

Risk propensity and prefactual thinking

Both sensation seeking and behavioural inhibition correlated significantly with positive prefactual thinking but not with negative. To explore this inferentially, four separate regressions were carried out for each risk measure on each type of prefactual outcome. The regression coefficients for each analysis are displayed in Table 4.5.

Sensation seeking significantly predicted the number of positive outcomes generated but not negative, high sensation seekers generated more positive consequences than low sensation seekers.

Behavioural inhibition significantly negatively predicted the number of positive prefactual statements generated, the relationship between BIS scores and downwards prefactual marginally missed significance (p=.05). High BIS scorers generated less positive consequences and more negative consequences than low BIS scorers.

Table 4.5 The regression coefficients for the measures of risk propensity as predictors of positive and negative prefactual thinking.

	β	F	ΔR^2
Sensation Seeking			
Positive Outcomes	.33	19.16**	.11
Negative Outcomes	-.05	.38	.00
BIS			
Positive Outcomes	-.18	5.04*	.03
Negative Outcomes	.16	3.9	.02

Note. * p<.05 and ** p<.01

4.3.5 Correlations between Warning Perception Variables and Predictor/Mediator Variables

The variables were then correlated with the warning perception variables. The correlation coefficients are displayed in Table 4.6.

Table 4.6 The correlation coefficients for predictor variables and warning perception variables

	Hazard Perception	Intended Compliance
Anticipated Regret	.478**	.587**
Positive Outcomes	-.210**	-.331**
Negative Outcomes	.239**	.198*
CFC	.210**	.282**
Sensation Seeking	-.041	-.300**
BIS	.002	.265**

Note. * p<.05 and ** p<.01

Risk measures

Sensation seeking was significantly and negatively related to intentions to comply only. The higher the participants' sensation seeking scores the lower their intentions to comply with the warnings.

Behavioural inhibition was significantly related only to intentions to comply only. The higher the participants' BIS scores, the higher their intentions to comply with the warnings.

Mediator variables

The analysis revealed that both hazard perception and intended compliance were related to anticipated regret. The more regret the participants anticipated from non-compliance, the higher their hazard perception and intentions to comply with the warnings were.

Both hazard perception and intended compliance were negatively related to the number of positive outcomes identified. The more positive consequences of non- compliance the participants generated, the lower their hazard perception and intentions to comply with the warnings. Similarly both hazard perception and intended compliance were related to the number of negative outcomes identified. The more negative consequences of non-compliance the participants generated, the higher their hazard perception and intentions to comply with the warnings.

Hazard perception and intended compliance were related to CFC scores. The higher the participants' consideration of future consequences, the higher their hazard perception and intentions to comply with the warnings were.

4.3.6 The Strongest Predictor of Hazard Perception

As both risk-taking propensity measures were not significantly related to hazard perception, the analysed to see which of the other variables did predict hazard perceptions. A multiple regression was carried out to determine the best predictor of hazard perception with only the variables found to be significantly correlated as predictors. The standardised regression coefficients are displayed in Table 4.7.

Table 4.7 The regression coefficients for the predictors of warning perception

Predictors	b	SE *b*	β
Constant	27.15	6.74	
CFC	1.86	1.46	.09
Anticipated Regret	6.55	1.21	.40**
Positive Outcomes	-1.60	.90	-.13
Negative Outcomes	.52	.22	.17*

Note: * p<.05, **p<.01

The analysis revealed that the model did significantly predict hazard perception, $F_{(1,154)}$= 14.58, p<.001, ΔR^2=.26. Inspection of the regression of the coefficients revealed that anticipated regret was the strongest predictor of hazard perception, with high anticipated regret predicting high hazard perceptions. The number of negative outcomes identified was also a significant predictor, with higher numbers of negative potential consequences leading to higher hazard perception. Scores on the CFC scale and the number of positive outcomes identified were not significant predictors of hazard perception in this model, therefore they did not explain any more of the variance in hazard perception than that explained by anticipated regret and negative prefactual thinking.

4.3.7 What Mediates the Relationship between Risk-Taking Propensity and Intended Compliance?

As the risk measures and potential mediators were inter-correlated, and each was related to intentions to comply (with the exception of negative prefactuals), it is possible one or more of these variables may mediate the relationship between the risk measures and intended compliance. For mediation to occur four conditions must be met (Baron & Kenny, 1986). First, the independent variable must significantly predict the dependant variable. Second, the independent variable must significantly predict the mediator. Third, the mediator must significantly predict the dependant variable when the independent variable is controlled for. Fourth, when controlling for the mediator variable the effect the independent variable has on the dependant becomes non-significant.

Step wise multiple regressions were carried out to determine which, if any of the potential mediator variables did in fact mediate the relationship between risk-taking propensity and intended compliance. If the effect of risk-taking propensity on intentions to comply becomes non-significant with addition of the potential mediator variables mediation may occur. Two analyses were conducted, one for each risk measure. Risk-taking propensity was entered in the first step; positive outcomes added in the second step, CFC scores in the third and anticipated regret in the fourth. The results for the analyses with sensation seeking as the measure of risk-taking propensity are presented first, followed by the results of the analyses with behavioural inhibition.

Sensation Seeking

The regression coefficients for the regression analyses with sensation seeking as the measure of risk-taking are present in Table 4.8.

Table 4.8 The regression coefficients for potential mediator variables controlling for sensation seeking

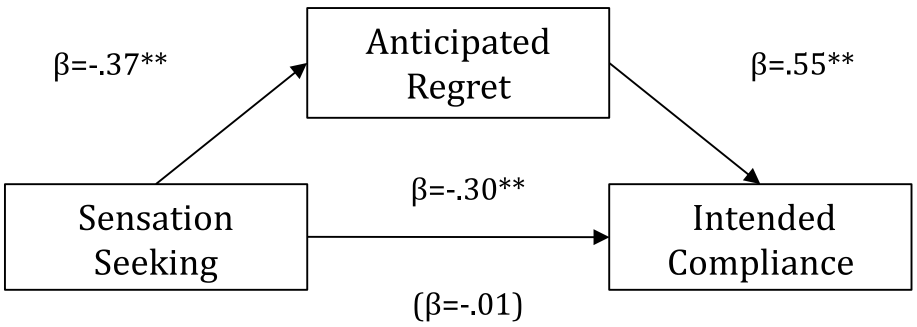
Predictors	b	SE *b*	β	ΔR^2	R^2 Change
Step 1				.08	
Constant	6.26	.23			
Sensation Seeking	-.04	.01	-0.3**		
Step 2				.14	.06**
Constant	6.11	.23			
Sensation Seeking	-.03	.01	-.21**		
Positive Outcomes	-.17	.05	-.26**		
Step 3				.19	.06**
Constant	5.16	.36			
Sensation Seeking	-.02	.01	-.163*		
Positive Outcomes	-.17	.05	-.27**		
CFC	.25	.07	.24**		
Step 4				.39	.20**
Constant	3.0	.43			
Sensation Seeking	-.00	.01	-.02		
Positive Outcomes	-.13	.04	-.20**		
CFC	.17	.07	.17*		
Anticipated regret	.41	.06	.50**		

Note. * p<.05 and ** p<.01

The first step revealed that sensation seeking significantly predicted intended compliance $F(1,154)= 15.23$, $p<.001$. The addition of positive prefactual thinking significantly improved the model, F change (2,153) = 10.79, $p=.001$, positive prefactual thinking was a significant predictor of intended compliance. The addition of CFC scores significantly improved the model F change (3,152) = 10.81, p=.001). Finally, the addition of anticipated regret in step three further improved the model, F change (4,151) = 51.83, $p<.001$.

Anticipated regret was the strongest predictor of intentions to comply, followed by positive prefactual thinking and CFC scores. As the amount of variance explained by sensation seeking remained significant when CFC scores and positive outcomes were added, both these variables cannot be considered mediatory variables in this analysis (Baron & Kenny, 1986). As sensation seeking became non-significant when anticipated regret was entered into the model in step four, it appears that the effect sensation seeking has on intended compliance may be mediated by anticipated regret.

In order to formally test this, a mediational analysis was carried out. Using the four steps recommended by Baron and Kenny (1986), three regression analyses were carried out on the data (see Figure 4.1 for an illustration of the relationships with beta coefficients). The significance of the mediation was then obtained using a Sobel calculator (Preacher & Leonardelli, 2010). The results of the analysis suggest that the relationship between sensation seeking and intended compliance is partially mediated by anticipated regret, Sobel z=-3.50, *p*<.001. Higher sensation seekers experienced lower anticipated regret and in turn held lower intentions to comply with the warnings than low sensation seekers.



*Note: β = Standardised beta, *p=<.05, **p=<.01.*
Numbers in parenthesis represent the indirect association between the independent variable and the dependant variable when controlling for the mediator

Figure 4.1 Mediation analysis for anticipated regret as a mediator between sensation seeking and intended compliance

Behavioural Inhibition

The regression coefficients for the regression analyses with sensation seeking as the measure of risk-taking are present in Table 4.9.

Table 4.9 The regression coefficients for potential mediator variables controlling for BIS scores

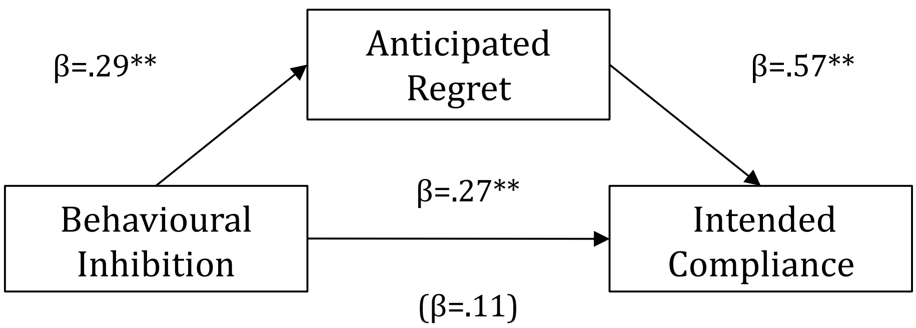
Predictors	b	SE *b*	β	ΔR²	R² Change
Step 1				.06	
Constant	4.40	.30			
BIS	.05	.01	.27**		
Step 2				.14	.08**
Constant	4.71	.29			
BIS	.04	.01	.21**		
Positive Outcomes	-.19	.05	-.29**		
Step 3				.19	.05**
Constant	4.13	.34			
BIS	.03	.01	.16*		
Positive Outcomes	-.19	.05	-.30**		
CFC	.25	.08	.24**		
Step 4				.40	.21**
Constant	2.80	.34			
BIS	.01	.01	.06		
Positive Outcomes	-.13	.04	-.20**		
CFC	.17	.07	.16*		
Anticipated regret	.41	.06	.50**		

Note. * p<.05 and ** p<.01

The first step revealed that BIS significantly predicted intended compliance $F(1,154)= 11.64$, $p=.001$. The addition of positive outcomes significantly improved the model, F change (1,153) = 13.85 $p<.001$, positive outcomes thinking was a significant predictor of intended compliance. The addition of CFC scores significantly improved the model F change (1,152) = 13.19, $p<.001$. Finally, the addition of anticipated regret in step three further improved the model, F change (1,151) = 26.40, p<.001.

Anticipated regret was the strongest predictor of intentions to comply, followed by positive prefactual thinking and CFC scores. The amount of variance explained by BIS remained significant until anticipated regret was entered into the model in step four. Therefore, it appears that the effect BIS has on intended compliance may be mediated by anticipated regret and not CFC or positive prefactual thinking.

In order to test this formally, another mediational analysis was carried out in the same manner as the previous mediational analysis. The results of the analysis suggest that the relationship between BIS and intended compliance is partially mediated by anticipated regret, Sobel z=-3.37, *p*<.001. See Figure 4.2 for an illustration of the relationships with beta coefficients. Participants with high behavioural inhibition experienced higher anticipated regret and in turn held higher intentions to comply with the warnings than low scorers.



*Note: β = Standardised beta, *p=<.05, **p=<.01.*
Numbers in parenthesis represent the indirect association between the independent variable and the dependant variable when controlling for the mediator

Figure 4.2 Mediation analysis for anticipated regret as a mediator between behavioural inhibition and intended compliance

Although prefactual thinking did not mediate the relationship between risk-taking propensity and intended compliance, it is possible that positive prefactual thinking may mediate the relationship between risk-taking propensity and anticipated regret. In order to explore this step wise regressions were carried out with prefactual thinking in the first step and risk-taking propensity in the second. The result for each risk measure is presented separately.

Sensation Seeking

The regression coefficients for the regression analyses with sensation seeking as the measure of risk-taking are present in Table 4.10.

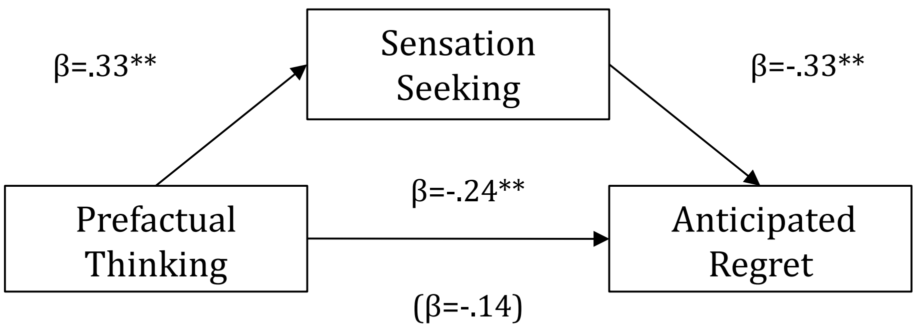
Table 4.10 The regression coefficients for positive prefactual thinking and sensation seeking on anticipated regret

Predictors	b	SE *b*	β	ΔR^2
Step 1				.05
Constant	4.86	.07		
Positive Outcomes	-.19	.06	-.24**	
Step 2				.14
Constant	5.95	.27		
Positive Outcomes	-.10	.06	-.14	
Sensation Seeking	-.05	.01	-.33**	

Note. * p<.05 and ** p<.01

The first step revealed that positive prefactual thinking significantly predicted anticipated regret $F(1,154)= 9.69$, $p<.01$. The addition of sensation seeking significantly improved the model, F change (2,153) = 13.96, R^2 Change= .10 p<.001). As positive prefactual thinking became non-significant when sensation seeking was entered into the model in step two, it appears that prefactual thinking does not mediate the relationship between sensation seeking and anticipated regret, rather the effect positive prefactual thinking has on anticipated regret may be mediated by sensation seeking.

In order to test this formally, a mediational analysis was carried out in the same manner as the previous mediational analyses. The results of the analysis suggest that the relationship between positive prefactual thinking and anticipated regret is partially mediated by sensation seeking, Sobel z=-3.05, $p<.001$. See Figure 4.3 for a graphical representation of the relationships.



*Note: β = Standardised beta, *p=<.05, **p=<.01.*
Numbers in parenthesis represent the indirect association between independent variable and the dependant variable when controlling for the mediator

Figure 4.3 Mediation analysis for sensation seeking as a mediator between positive prefactual thinking and anticipated regret

Behavioural Inhibition

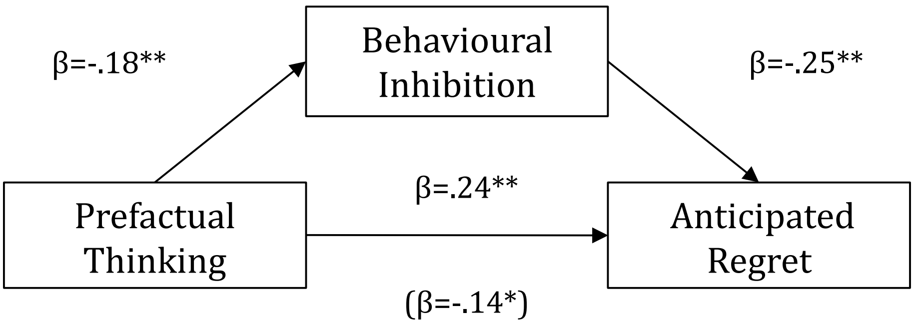
The regression coefficients for the regression analyses with sensation seeking as the measure of risk-taking are present in Table 4.11.

Table 4.11 The regression coefficients for positive prefactual thinking and behavioural inhibition on anticipated regret

Predictors	b	SE *b*	β	ΔR^2
Step 1				.05
Constant	4.86	.07		
Positive Outcomes	-.19	.06	-.24**	
Step 2				.11
Constant	3.72	.36		
Positive Outcomes	-.15	.06	-.20*	
Behavioural Inhibition	.05	.02	.25**	

Note. * p<.05 and ** p<.01

The first step revealed that positive prefactual thinking significantly predicted anticipated regret $F(1,154)= 9.69$, $p<.01$. The addition of behavioural inhibition significantly improved the model, F change (2,153) = 10.36, R^2 Change= .06, p<.001). As positive prefactual thinking remained highly significant when behavioural inhibition was entered into the model in step two, it appears that both positive prefactual thinking and behavioural inhibition have relatively independent effects on anticipated regret. The Sobel calculation for behavioural inhibition as a mediator of the relationship between positive prefactual thinking and anticipated regret missed significance, Sobel z=-1.85, *p*=.065. See Figure 4.4 for a graphical representation of the relationships.



*Note: β = Standardised beta, *p=<.05, **p=<.01.*
Numbers in parenthesis represent the indirect association between independent variable and the dependant variable when controlling for the mediator

Figure 4.4 Mediation analysis for behavioural inhibition as a mediator between positive prefactual thinking and anticipated regret

4.4 Discussion

Consistent with the findings of the previous studies, both measures of risk-taking propensity predicted intentions to comply with the warning stimuli. Sensation seeking negatively predicted intended compliance, accounting for approximately 8% of the variance. High sensation seekers held lower intentions to comply with the warnings than low sensation seekers. Behavioural inhibition positively predicted intentions to comply, accounting for approximately 6% of the variance. Participants with high BIS scores held higher intentions to comply with the warnings than participants with low scores. Both sensation seeking and behavioural inhibition were also found to predict intentions to comply in Study One, therefore these constructs appear to influence reliably compliant intentions towards contextual warnings.

As predicted, both risk-taking propensity measures were related to all potential mediator variables, with the exception of negative outcomes. High risk-takers (as defined by high sensation seeking or low BIS scores) held lower considerations for the future and anticipated less regret from non-compliance than low risk-takers. High risk-takers also generated more positive consequences of non-compliance than low risk-takers. Unexpectedly, both risk-taking measures did not significantly affect number of negative outcomes generated by participants.

These findings are consistent with the definition of sensation seeking, which suggest that such individuals are willing to accept high levels of risk for the intense and novel experiences that they will gain rather than take risk for its own sake (Zuckerman, 1994). As high sensation seekers appear to simulate spontaneously more positive outcomes, it is possible that this simulation may bias their risky decisions. Previous research has found that high sensation seekers focus on benefits or positive outcomes of risky behaviour more than low sensation seekers (Cloninger, 1987; Horvath & Zuckerman, 1993; Steketee & Frost, 1994). This may be driven by their tendency to simulate spontaneously more positive outcomes than negative. Although sensation seekers do appear to hold low risk perceptions (e.g.

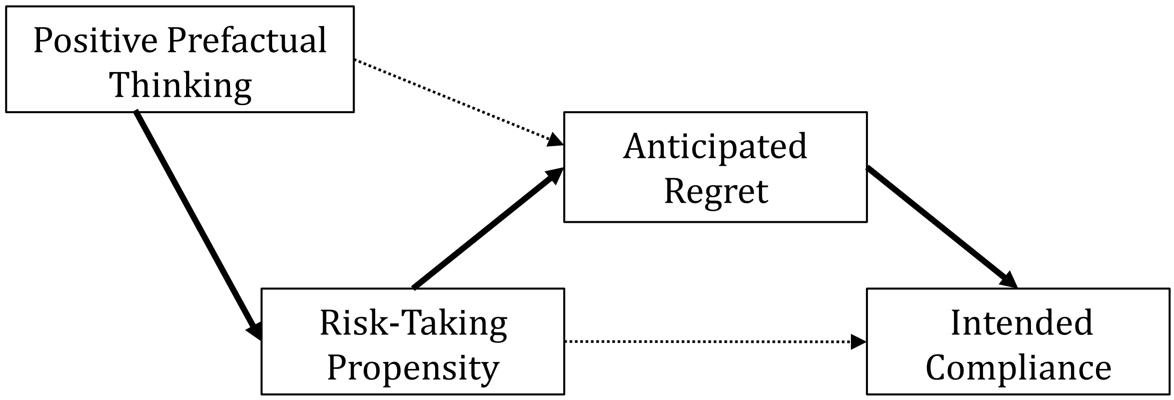
Franken et al., 1992; Jonah et al., 2001; Rosenbloom, 2003; Witte & Donohue, 2000), it appears that this is not the result of some deficiency in ability to simulate negative outcomes as sensation seeking did not affect generation of negative outcomes. While these results are theoretically consistent with sensation seeking, the fact that BIS scores were related to positive simulation are at odds with the definition of behavioural inhibition. The behavioural inhibition system is conceived as a structure which motivates avoidance by increasing attention to potential dangers (Gray & McNaughton, 2000) and is sensitive to punishment rather than reward. In present study, the relationship between BIS scores and negative outcomes just missed significance. This suggests that individuals high in BIS may indeed simulate more negative consequences than those low on the construct, however BIS predicted simulation of positive consequences more robustly.

The results show that all potential mediator variables were related to warning perceptions and that anticipated regret was the strongest predictor of both hazard perception and intended compliance. The more regret participants anticipated experiencing after non-compliance with the warnings, the higher their hazard perceptions and intentions to comply with them. This is consistent with research which has found anticipated regret to relate to compliance and safety related behaviours (Crawford et al., 2002; Gleicher et al., 1995; Kalsher & Williams, 2006; Richard et al., 1996). Prefactual thinking was related to both warning perception variables; however, positive simulation was a stronger predictor of intentions to comply whereas negative simulation was a better predictor of hazard perception. These findings suggest that while the simulation of positive and negative outcomes may affect both hazard perception and intentions to comply with warnings, imagining how non-compliance will be detrimental is more influential for hazard perception and imagining how non-compliance will be beneficial is more influential for intentions to comply. Scores on the CFC scale were related to both hazard perception and intentions to comply; however, CFC scores were a stronger predictor of intentions to comply. This suggests individuals who tend to consider the longer term consequences of their decisions are more likely to comply with warnings than those who ‘live for the moment’.

The main aim of the present study was to explore the theoretical underpinnings of the results of the relationship between risk-taking propensity and warning perceptions. The results of the mediational analyses suggest that anticipated regret mediated the relationship between both measures of risk-taking and intended compliance rather than consideration of future consequences or prefactual thinking. It appears that when faced with a warning, high risk-takers anticipate less regret from non-compliant behaviour and this affects their intentions to comply. The fact that this relationship was replicated for both sensation seeking and behavioural inhibition suggests that the present findings are reliable, although anticipated regret mediated slightly more of the effect for sensation seeking than for behavioural inhibition.

It was also found that sensation seeking partially mediates the relationship between positive prefactual thinking and anticipated regret. This suggests that high sensation seekers tend to generate more positive prefactuals which leads them to anticipate less regret, which in turn may affect their compliant intentions. Alternately, people who generate more positive prefactuals may be more likely to be high sensation seekers, and therefore anticipate less regret and in turn hold lower compliant intentions. Behavioural inhibition did not reach significance as a mediator of the relationship between prefactual thinking and anticipated regret; therefore, it is not clear if this relationship exists for other risk-taking propensity measures.

The relationships between positive prefactual thinking, risk-taking anticipated regret and intended compliance described may be set out in a preliminary model based on the current findings. Figure 4.5 illustrates the potential indirect relationships accounted for by the mediational analyses conducted within this chapter. The implications of and confidence held in this model are discussed further in Chapter 6.



Note: the arrows in bold represent the significant indirect relationships between variables, whereas the dashed line represent the non-significant direct relationships

Figure 4.5 The proposed mediatory relationships between risk-taking propensity and intended compliance.

There are a few methodological considerations which may have affected the results of the present study, particularly concerning the measurement of prefactual thinking. First, it was assumed that the prefactual outcomes generated were spontaneous in nature and should reflect an individual's mental simulations in a realistic situation. However, it is important to consider that the participants may not have reported all the outcomes they simulated. This may mean that participants actually simulated more prefactuals. However, the extent to which they did so and the direction of those prefactuals is unknown therefore it is impossible to estimate the implications this may have on the current study. This may particularly be the case as participants were asked to type their responses thus allowing them time to filter or inhibit their responses. It is possible that asking participants to give their responses verbally may have decreased the possibility of unreported prefactuals and maybe a better approach in future research.

Second, an important consideration arises from the way in which prefactual statements were coded. The coding process focused on the number and direction of prefactual statements reported. This method did not take into account the saliency or magnitude of the simulations generated. When considering a warning about sunscreen use, the prefactual statement 'I will get sunburnt' is far less severe than the statement 'I will get skin cancer'; however, they were treated equally in the coding process. Research has shown that the severity of a potential negative outcome has a substantial influence on attitudes towards warnings (Wogalter et al., 1991), therefore this may be an important factor to consider.

Third, another point to consider concerning the positive prefactual generations is that in most cases prefactual thinking was rare. It also appears the most of the positive prefactuals were generated in relation to four warnings in particular which may have skewed the results.

These potential limitations are however restricted to the validity of the prefactual measure, therefore the main finding, that anticipated regret mediated risk-takers' intentions to comply with warnings should be unaffected. However, the counterbalancing of anticipated regret and the prefactual measures may have primed participants to respond in a certain way. For example, when the prefactual measure was presented first the extent to which they considered the positive and negative outcomes may have influenced how much regret they anticipated and vice versa. Indeed it was found that when anticipated regret was measured first, participants reported higher regret than when prefactuals were measured first. Although this finding missed significance narrowly, it may have implications for the validity of the study and therefore interpretations may be treated with caution.

Nevertheless, the findings of the present study have practical implications for warning design. As anticipated, regret appears to mediate the effect risk-taking propensity has on intended compliance, it is clear that warnings designed to increase anticipated regret may be more effective for risk-takers. However it is not clear what may be the most appropriate way to do so. It is difficult to design warnings which directly prime regret in a naturalistic way. Therefore attempts to manipulate factors which affect anticipated regret may be successful.

The present study found that anticipated regret was related to both positive and negative prefactual thinking, therefore warnings which encourage negative prefactual thinking and discourage positive prefactual thinking may increase anticipated regret. Counter-intuitively, the present findings suggest that anticipated regret is more closely associated with positive prefactual thinking than it is with negative. Also in the present study risk-taking propensity was found to relate to positive prefactual thinking more robustly than negative prefactual thinking. Therefore, warnings which decrease positive prefactual simulations (or increase negative prefactual simulation so that is it is in line with positive) may promote anticipated regret in high sensation seekers which in turn may increase intentions to comply with warnings. The next study therefore aimed to minimise the difference in intended compliance between high and low risk-takers using warnings designed to increase negative prefactual simulation and warnings designed to decrease positive prefactual simulation.

Chapter Five

Study Five: Minimising the Relationship between Risk-Taking Propensity and Warning Perception through Warning Design

5.1 Introduction

The studies presented so far establish the effect that various measures of risk-taking propensity have on intentions to comply with warnings and hint at the theoretical mechanisms that may underpin these relationships. The findings of the previous study suggest that anticipated regret partially mediates the relationship between risk-taking propensity and warning perception. High risk-takers anticipated less regret from non-compliance with a warning than low risk-takers. In addition, high risk-takers were found to simulate more positive prefactual outcomes than low risk-takers when presented with warnings although sensation seeking did not affect the number of negative prefactual outcomes stimulated (the relationship for behavioural inhibition narrowly missed significance). Also, sensation seeking appeared to mediate the relationship between positive prefactual thinking and anticipated regret.

These findings may have practical implications for warning design and implementation. Warnings that increase anticipated regret in high sensation seekers should also increase their intentions to comply. The question is how can warnings be designed to increase anticipated regret? While it is possible to prime directly anticipated regret in some types of risk communications e.g. public service announcements (Grow & Christopher, 2008), it is difficult to do so in warning labels like those implemented in this thesis. Therefore it may be advantageous to consider other factors which bring about anticipated regret. As discussed in the previous study, anticipated regret is thought to be produced by prefactual mental simulation (e.g. Gleicher et al., 1995). Warnings which prime prefactual thinking should increase anticipated regret which should in turn increase compliant intentions.

One obvious approach is to make the negative outcomes more salient by explicitly outlining the warning consequence statement. Warning research has found this to be an effective way to increase warning perceptions and encourage appropriate behaviour (see Laughery, 2006, for a review). For example Laughery and Stanush (1989) found that warnings with highly explicit consequences (e.g. 'do not exceed recommended dosages because nervousness, dizziness, or sleeplessness may occur') were perceived as more hazardous than non-explicit consequences (e.g. 'do not exceed recommended dosages because undesirable effects may occur'). These findings could be explained by prefactual thinking. Explicit negative outcomes may facilitate negative prefactual simulation and produce higher levels of anticipated regret, which in turn may affect warning perceptions. This suggests that in order to increase anticipated regret in sensation seekers we must over-emphasise the negative consequences of non-compliance in order to bring their negative prefactual simulation to a level which outweighs their over simulation of positive outcomes. However, this approach may not be advantageous in all circumstances. Hazard or urgency matching is highly recommended within warning design literature (e.g. Edworthy, 1998; Edworthy & Adams, 1996; Hellier et al., 2000; Wogalter & Silver, 1990b), therefore creating warnings which unrealistically over emphasise negative consequences are likely to be at odds with people's attitudes and beliefs about a hazard and may be less effective. This might particularly be the case for sensation seekers who are more prone to believing that risks do not apply to themselves as much as they do to others (Rosenbloom, 2003).

The other alternative is to increase anticipated regret by reducing positive prefactual simulation. Study Four suggests that sensation seeking, anticipated regret and intended compliance are more strongly related to positive prefactual thinking than they are to negative prefactual thinking, therefore it may be a more viable approach to design warnings which decrease the simulation of positive outcomes. One way to achieve this may be to design warnings which negate positive outcomes. Emphasising how high sensation seekers are not going to get the immediate rewards they want may be an effective way of increasing their anticipated regret and intentions to comply with warnings.

While both emphasising negative outcomes and negating positive outcomes of non-compliance are likely to increase anticipated regret and improve compliance, the fact that sensation seeking was related to positive simulation only suggests that warnings which negate positive outcomes may be more effective at minimising the discrepancy between high and low risk-takers. It is alternatively possible however, that in attempting to negate positive outcomes, they may be made more explicit and producing the opposite effect to that desired. The mental simulation of positive consequences is likely to have already occurred before an individual reads the warning. Instead of increasing high sensation seekers' compliance intentions, the warnings may increase the saliency of the positive consequences reminding the sensation seeker of the rewards that they may achieve from engaging in that behaviour.

The present study aimed to judge the efficacy of these ideas by comparing differences in intended compliance between high and low risk-takers across three warning conditions; a negative warning condition, a positive warning condition and a control condition. The statement of consequences was manipulated under each condition and all three conditions included a basic negative consequence statement. For the negative warning condition this was followed by two specific negative consequences with the intention that the warnings would increase negative prefactual thinking. For the positive warning condition the basic statement was followed by a statement which negated two positive outcomes of non-compliance with the intention that this would decrease positive prefactual thinking. The control condition warning consisted of the basic consequences statement only. Sensation seeking was chosen as the measure of risk-taking propensity in this study for a number of reasons, first it has been more widely used in the area of risk-taking propensity than any other construct (Llewellyn, 2008) and it has been frequently related to risk-taking behaviour. Second, it was more highly related to intentions to comply with warnings in Study Four than the BIS. Third, sensation seeking was a more significant mediator of the relationship between prefactual thinking and anticipated regret than was BIS.

An extreme groups design was implemented for three reasons; first to maximise variation and increase power (Iacobucci, 2001; Kagan, Snidman, & Arcus, 1998), second to maximise cost-efficiency (Preacher, Rucker, MacCallum, & Nicewander, 2005) and third, as extreme group designs are considered optimal for identifying potential interactions (McClelland & Judd, 1993) i.e. the potential interaction between warning condition and sensation seeking group. Conclusions drawn from this approach are subject to certain caveats (Preacher et al.) which will be examined in the discussion section. Participants were initially screened for their sensation seeking score; high and low sensation seekers were recalled to complete the warning task. Participants were allocated to one of three warning conditions (negative, positive and control) differing only in terms of the warning stimuli. The warning task measured hazard perception and intentions to comply with the warnings in the same manner as the previous studies. A measure of anticipated regret was also included to determine if the warning condition had influenced this variable. A pilot study was carried out to select behaviours for contextual information of the warnings, as it was important that each context could be feasibly made into a believable warning under each condition.

It was predicted that the positive warnings, designed to negate the positive consequences of non-compliance, may be more effective for high sensation seekers as Study Four found such people differed from low sensation seekers in the simulation of positive consequences only. It was expected that the discrepancy in hazard perception, intended compliance and anticipated regret between high and low sensation seekers would be largest for the control condition and smallest for the positive warning condition. Based on the result of the previous study, it was also predicted that the relationship between sensation seeking and intended compliance would be partially mediated by anticipated regret.

5.2 Pilot study

The aim of the pilot study was to select behaviours to form the contextual information for the warnings stimuli. Participants were presented with a list of risky behaviours, and were asked to rate the risk level of each behaviour and to list potential positive and negative consequences of engaging in each behaviour. As it was important to ensure that the behaviours had commonly accepted positive and negative consequences, 10 behaviours were selected on the basis of the frequency that participants reported similar positive and negative consequences of engaging in the behaviour and their suitability to be converted into plausible warnings.

5.2.1 Method

Participants

Forty eight participants (23 males and 25 females) aged 18 to 56 (M= 31.36) were recruited by opportunity sampling, and participated over an internet connection.

Materials

Participants were presented with a list of 24 risky behaviours from health & safety, recreational and financial domains. The behaviours chosen for the potential warning contexts are outlined here.

1. Driving without a seat belt
2. Rock climbing without a harness
3. Riding a motorcycle without a helmet
4. Exceeding the recommended units of alcohol a week
5. Going down a ski run that is beyond your ability
6. Binge drinking on a night out
7. Sunbathing without sunscreen
8. Swimming at a beach not manned by life guards
9. Having unprotected sex with someone you just met
10. Smoking over 20 cigarettes a day
11. Driving when you feel drunk
12. Taking illegal drugs (class A)
13. Breaking the speed limit in a residential area by more than 10mph
14. Running a red light at a train crossing
15. Walking home alone at night in an unsafe area of town
16. Regularly betting on an internet gambling site
17. 'Tomb-stoning' or cliff diving (Jumping off a cliff or tall bridge etc. into water in an uncontrolled environment)
18. Crossing a dual carriage way without using a pedestrian crossing
19. Back-packing in a politically unstable country
20. Listening to music above 90db for a prolonged period of time
21. Betting a day's income at a high-stake poker game
22. Smoking marijuana
23. Having a large number of sexual partners
24. Driving a meter away from a car in front of you on a motorway

Procedure

Participants were asked to rate each one in terms of their level of risk or 'dangerousness'. Participants were given a 10 point likert scale ranging from ' Not at all risky' to ' Extremely risky' to aid their judgements. Participants were also asked to list as many positive and negative consequences as they could for each behaviour. As the pilot task was computerised, participants were provided with two text boxes to list the positive and negative consequences separately.

5.2.2 Analysis and Results

The mean score for each behaviour was calculated and rank ordered (see Appendix 5A). Participants' responses were coded using thematic analysis; this is where patterns or themes are identified in a text (see Braun & Clarke, 2006). The frequency of each theme (consequence) was recorded. The three most frequently reported positive and negative consequences for each behaviour are also displayed in Appendix 5A. The final behaviours (ten experimental stimuli and three practice stimuli) were selected for the high frequency of similar positive and negative consequences as well as their suitability to be converted into plausible warnings. The behaviours were also chosen to represent (approximately) high, medium and low risk behaviours on the basis of participants' mean risk perception responses. The practice warning stimuli consisted of a highly rated behaviour, the lowest rated behaviour and a behaviour from the median point to calibrate participants' responses appropriately.

Some of the selected behaviours fell under the health & safety domain of risk and some fell under the recreational domain in order to avoid homogeneity. The number of behaviours selected from each domain was not controlled as the priority for behaviour selection was the frequency of reported consequences. The behaviours selected for experimental and practice stimuli are displayed in Table 5.1 with their relative risk levels.

Table 5.1 The behaviours used as warnings stimuli context and their prejudged relative risk levels

Behaviour	Risk rating (m)
Experimental Stimuli	
Smoking marijuana	4.27
Crossing a dual carriage way without using a pedestrian crossing	5.23
Regularly exceeding the recommended units of alcohol a week	5.83
Sunbathing without sunscreen	6.23
Listening to music above 90db for a prolonged period of time	6.29
Breaking the speed limit in a residential area by more than 10mph	6.58
Going down a ski run that is beyond your ability	7.15
Having unprotected sex with someone you just met	7.96
'Tomb-stoning'	7.96
Running a red light at a train crossing	8.71
Practice Stimuli	
Swimming at a beach not manned by life guards	4.23
Walking home alone at night in an unsafe area of town	6.33
Driving when you feel drunk	8.60

5.3 Pre-screen

5.3.1 Method

Participants

Three hundred and thirty eight undergraduate students participated in the study for course credit, of these 59 were male and 279 were female. Participants were aged between 18 and 50 years (M=21.54, SD=5.43) and no other demographic information was recorded.

Materials and Procedure

Participants completed the sensation seeking scale form V (SSSV; Zuckerman, 1994 in Appendix 2D) online with the expectation that they may be invited back to participate in the second stage of the study on the basis of their scores on the task. It was not made apparent on what basis they would be recalled until after the main experiment had been completed.

5.3.2 Results

Reliability analyses were carried out on the sensation seeking scores. The descriptive statistics for the sensation seeking pre-screen are displayed in Table 5.2 along with the Cronbach's alpha coefficients. The analysis indicated very high reliability for all scales (Kline, 1999).

Table 5.2 Mean and range of sensation seeking scores for the pre-screen study

	Mean (SD)	Minimum	Maximum	α
Sensation Seeking Total	20.30 (6.15)	2	33	.99
Thrill and Adventure Seeking	5.76 (2.39)	0	9	.96
Experience Seeking	5.79 (2.03)	0	10	.94
Dis-inhibition	5.80 (2.42)	0	10	.97
Boredom Susceptibility	2.97 (1.90)	0	8	.90

The scores were then rank ordered and a tertile split was performed on the data. Participants whose scores fell in the top third of the classed as high sensation seekers, and participants whose scores fell in the bottom third were classed as low sensation seekers. Participants from these extreme groups were contacted and invited to take part in the main study.

5.4 Main study

5.4.1 Method

Participants

One hundred and ninety undergraduate students were successfully recalled for the main experiment and participated for further course credit, of these, 38 were male and 152 were female. Participants were aged between 18 and 50 years (M=21.35, SD=5.49) and no other demographic information was recorded.

The participants were allocated to the three conditions before participation with the view to achieve approximately equal numbers of high and low sensation seeking participants in each condition. The actual number of participants in each condition and their mean sensation seeking scores are displayed in Table 5.3.

Table 5.3 The number of participants in each condition group and their mean sensation seeking score

Warning Condition	Control		Negative		Positive	
	N	M (SD)	N	M (SD)	N	M (SD)
High SS group	33	26.55 (3.18)	31	26.71 (2.98)	32	26.03 (2.16)
Low SS group	32	13.09 (4.15)	31	12.84 (3.88)	31	13.23 (3.6)

Materials

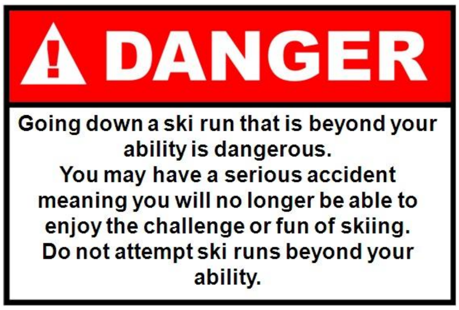
The warning task was a computer program which presented participants with 13 visual warning labels (10 experimental warnings and three practice trials where no recorded).

The warning stimuli were in the form of warning labels and all features apart from the message were identical to the warnings implemented in the previous study.

As previously mentioned a pilot study was carried out to select the behavioural contexts for the stimuli, the behaviours chosen are displayed in Table 5.1. The contextual information of the message included a statement about the nature of the hazard, a statement about the consequences of not following the warning and instructions for mitigating the consequences of the hazard. All statements were definitive in tone (e.g. riding a motorcycle without a helmet *is* dangerous). The statement of the consequences of non-compliance was manipulated across the warning conditions while both the statement of the nature of the hazard and the instructions for mitigating the hazard were kept constant across conditions. For the control warnings, the negative of consequences of non-compliance was highlighted but not made explicit. For example, the basic consequence statement for the behaviour 'sunbathing without sunscreen' was 'you may cause long term damage to your skin'. For the other two conditions, the same basic consequence statement was used but was expanded upon. In the negative condition this was achieved by outlining two specific negative consequences explicitly. Using the 'sunbathing without sunscreen' example, the basic consequence statement was expanded upon with two negative consequences within the same sentence. For example, 'you may cause long term damage to your skin **resulting in premature aging** and **skin cancer'**. For the positive condition this was achieved by outlining how the basic consequence meant that participants would not gain two positive consequences of that particular behaviour within the same sentence. For example, 'you may cause long term damage to your skin that will **appear unsightly** and **prevent you from tanning in the future**'. See Figure 5.1 for an illustration of the three versions (control, negative and positive) of the same basic warning and Appendix 5B for the full warning stimuli.

Control Condition
Basic consequences statement

Negative Condition
Basic consequences statement expanded by outlining two negative consequences



Positive Condition
Basic consequences statement expanded by negating two positive consequences

Figure 5.1 An example of the three experimental versions of the same warning

In the same manner as the warning tasks used in the previous studies, the warnings were randomly presented one at a time. Participants were asked to give three responses for each one; a measure of hazard perception, intended compliance and anticipated regret. Participants' hazard perception and intentions to comply were measured in a manner consistent with previous studies.

Anticipated regret was measured by presenting the participants with a statement similar to that used by Abraham and Sheeran (2004). Participants were asked to indicate the extent to which they agreed on a 7 point Likert scale (in keeping with the intended compliance measure) ranging from 'definitely agree' to 'definitely disagree'. The statements varied according to the warning context, however the structure remained the same, for example '**If I** *did not wear a helmet while riding a motorcycle* **I would feel regret'**. See Appendix 5C for a list of the statements.

Design & Procedure

The study employed a 3 (warning condition; control, negative and positive) x 2 (sensation seeking; high vs. low) ANOVA design. The study was conducted in a laboratory setting, with participants sat at computer desks to compete the warning task. A screen shot from the task can be found in Appendix 5D and the instructions for the task can be found in Appendix 5E and were presented on screen.

5.4.2 Results

As sensation seeking was a 'between-subjects' measure a potential confound may arise from the distributions of participants' sensation seeking scores across the warning conditions. To ensure that there was no significant difference in the mean sensation seeking score for high and low sensation seekers across each of the warning conditions, an ANOVA was carried out with SSS-V score as the dependant variable and condition and sensation seeking group as independent variables. The analysis revealed that there was no significant difference in SSS-V score across the three conditions, $F(2, 184) = .06$, $p=.95$. The analysis revealed no significant interaction between condition and SS group, $F(2, 84)= .39$, $p=.68$. The mean sensation seeking scores for high and low sensation seeking groups did not differ across conditions. Therefore the main analyses should not be confounded by differences in sensation seeking scores across conditions.

To determine if there were significant differences in mean hazard perception, intended compliance and anticipated regret scores across warning condition and sensation seeking group, three separate ANOVAs were carried out for each dependant variable separately.

Hazard Perception

The analysis revealed no significant main effect of warning condition $F(2, 184) = .37$, $p = .69$. Therefore there was no difference in participants' mean hazard perception scores across the three different warnings conditions.

The analysis revealed a significant main effect of sensation seeking group, $F(1, 184) = 18.51$, $p < .001$, $\eta^2 = .09$. High sensation seekers gave significantly lower hazard ratings than low sensation seekers.

There was no significant interaction between warning condition and sensation seeking group, $F(2, 184) = .63$, $p = .53$. Therefore the difference between high and low sensation seekers' hazard perception scores did not significantly differ across conditions. Table 5.4 displays the mean hazard perception scores for high and low sensation seekers across the three warning conditions.

Table 5.4 Mean hazard perception scores for sensation seeking group across warning condition

Warning Type	Mean Hazard perception (SD)		
	High SS	Low SS	Total
Control	57.05 (17.61)	63.44 (15.17)	60.19 (16.64)
Negative	54.39 (16.33)	66.88 (13.11)	60.19(16.64)
Positive	53.56 (12.32)	63.29 (16.33)	58.35 (15.13)
Total	55.03 (15.51)	64.52 (14.86)	59.73 (15.51)

Intended Compliance

The analysis revealed no significant main effect of warning condition, $F(2, 184) = .29$, $p = .75$. Therefore there was no difference in participants' mean intended compliance scores across the three different warning conditions.

The analysis revealed a significant main effect of sensation seeking group, $F(1, 184) = 59.3$, $p < .001$, $\eta^2 = .24$. High sensation seekers gave significantly lower intentions to comply with the warnings than low sensation seekers.

There was no significant interaction between warning condition and sensation seeking group $F(2, 184) = 1.69$, $p = .19$. Therefore, the difference between high and low sensation seekers' intentions to comply with the warnings did not significantly differ across conditions. Table 5.5 displays the mean intended compliance scores for high and low sensation seekers across the three warning conditions.

Table 5.5 Mean intended compliance scores for sensation seeking group across warning condition

Warning Type	Mean Intended Compliance (SD)		
	High SS	Low SS	Total
Control	4.55 (.93)	5.34 (.85)	4.94 (.97)
Negative	4.19 (.86)	5.48 (.74.)	4.84 (1.03)
Positive	4.46 (.86)	5.26 (.92)	4.86 (.97)
Total	4.40 (.89)	5.36 (.84)	4.88 (.99)

Anticipated Regret

The analysis revealed no significant main effect of warning condition, $F(2, 184) = .11$, $p = .90$. Therefore there was no difference in participants' mean anticipated regret scores across the three different warnings conditions.

The analysis revealed a significant main effect of sensation seeking group, $F(1, 184) = 26.93$, $p < .001$, $\eta^2 = .13$. High sensation seekers gave significantly lower anticipated regret ratings than low sensation seekers.

There was no significant interaction between warning condition and sensation seeking group $F(2, 184) = .02$, $p = .98$. Therefore the difference between high and low sensation seekers' anticipated regret ratings did not significantly differ across conditions. Table 5.6 displays the mean anticipated regret scores for high and low sensation seekers across the three warning conditions.

Table 5.6 Mean anticipated regret scores for sensation seeking group across warning condition

Warning Type	Mean Anticipated Regret (SD)		
	High SS	Low SS	Total
Control	4.09 (1.10)	4.83 (.90)	4.46 (1.06)
Negative	4.03 (.99)	4.82 (.86)	4.42 (1.00)
Positive	4.15 (1.00)	4.86 (1.00)	4.50 (1.10)
Total	4.09 (1.02)	4.84 (.95)	4.46 (1.05)

Relationships between Dependant Variables

To confirm that the three dependant variables, hazard perception, intended compliance and anticipated regret were related, a Pearson's correlation was carried out on the raw sensation seeking scores. All dependant variables were strongly positively related; the correlation coefficients are presented in Table 5.7. The analysis revealed that intentions to comply with the warnings were more closely related to anticipated regret than were hazard perceptions.

Table 5.7 Correlation coefficients for the dependant variables hazard perception, intended compliance and anticipated regret

	Hazard Perception	Intended Compliance	Anticipated Regret
Hazard Perception	-		
Intended Compliance	.67**	-	
Anticipated Regret	.65**	.77**	-

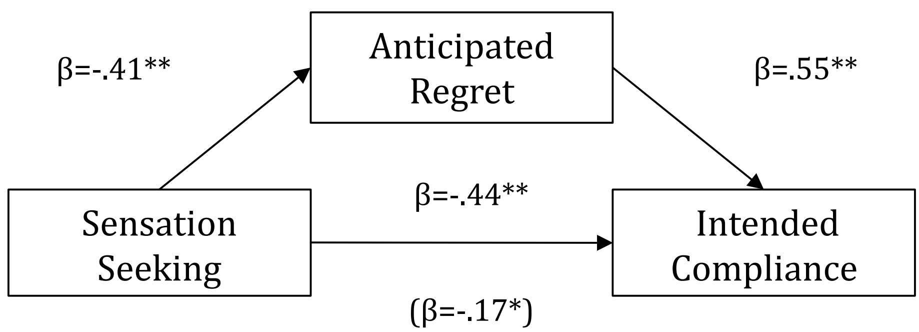
Does Anticipated Regret Mediate the Relationship between Sensation Seeking and Intended Compliance?

The results of Study Four suggested that anticipated regret partially mediates the relationship between sensation seeking and intended compliance. In order to see if this finding is replicated in the present data, a mediational analysis was carried out for each sensation seeking group separately. Using the four steps recommended by Baron and Kenny

(1986), three regression analyses were carried out on each data set. The significance of the mediation was then obtained using a Sobel calculator (Preacher & Leonardelli, 2010).

Low Sensation Seekers

The results of the analysis for the low sensation seeking group suggest that the relationship between sensation seeking and intended compliance is partially mediated by anticipated regret, Sobel z=-3.90, *p*<.001. See Figure 5.2 for an illustration of the relationships with beta coefficients.

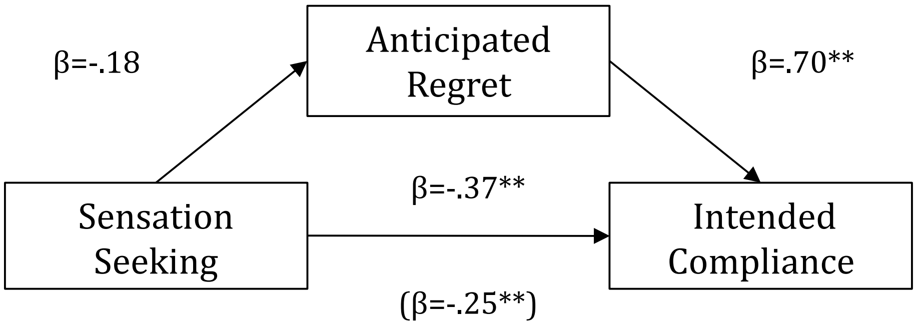


*Note: β = Standardised beta, *p=<.05, **p=<.01.*
Numbers in parenthesis represent the indirect association between the independent variable and the dependant variable when controlling for the mediator

Figure 5.2 Mediation analysis for anticipated regret as a mediator between sensation seeking and intended compliance in the low sensation seeking group

High Sensation Seekers

The relationship between sensation seeking and anticipated regret just missed significance, F(1, 94)=3.02, p=.085. The results of the Sobel calculations analysis also just missed significance for the high sensation seeking group, Sobel z=-1.71, *p*=.087. See Figure 5.3 for an illustration of the relationships with beta coefficients. Therefore, it is not clear whether anticipated regret partially mediates the relationship between sensation seeking and intentions to comply for the high sensation seeking group.



*Note: β = Standardised beta, *p=<.05, **p=<.01.*
Numbers in parenthesis represent the indirect association between the independent variable and the dependant variable when controlling for the mediator

Figure 5.3 Mediation analysis for anticipated regret as a mediator between sensation seeking and intended compliance in the high sensation seeking group

5.5 Discussion

Consistent with the previous studies, the present study revealed an effect of sensation seeking on intended compliance. The high sensation seeking group reported lower intentions to comply with the warnings than the low sensation seeking group. Contrary to Studies One and Four, which also implemented sensation seeking as a measure of risk-taking propensity, the present study also revealed a significant effect of sensation seeking on hazard perception. The high sensation seeking group perceived less hazard from the warnings than the low sensation seeking group. However, the effect size was much smaller for hazard perception than it was for intended compliance. Consistent with Study Four there was also an effect of sensation seeking on anticipated regret. The high sensation seeking group did anticipate less regret from non-compliance than did the low sensation seeking group. The effect size for intended compliance was larger than that for anticipated regret.

It was also found that anticipated regret partially mediated the relationship between sensation seeking and intended compliance for the low sensation seeking group. The same pattern of relationships for the high sensation seeking group indicated a trend as the Sobel test just missed significance. These findings replicate those of the previous study, however it appears that the mediatory role of anticipated regret may be stronger for individuals lower on the sensation seeking scale.

Together the present findings strengthen the argument that there is a relationship between risk-taking propensity and warning perception and that it is mediated by anticipated regret. Another finding of interest was that intentions to comply were more closely related to anticipated regret than they were to hazard perceptions. This is consistent with the findings of Chapman and Coups (2006) who found that anticipated regret was a better predictor of influenza vaccination than risk perception (i.e. compliance with health risk communications).

The main aim of the present study was to attempt to minimise the disparity in warning perception scores between high and low sensation seekers, however this was not achieved. The difference between high and low sensation seeking groups in the three dependant variables was similar for all warning types. Therefore, none of the three types of warnings implemented in this study were effective in minimising the discrepancy between high and low sensation seekers' warning perceptions. This could suggest that the observed relationship between sensation seeking and warning perception may be robust and not susceptible to warning design manipulations. However, there was no main effect of warning condition or any evidence of an interaction between warning condition and sensation seeking group. Overall the participants perceived no difference in hazard, held similar intentions to comply with and anticipated similar levels of regret from non-compliance with the three different versions of the warnings. This finding is contrary to the warning literature which has consistently demonstrated that manipulating the explicitness of the negative consequences statement has an effect on warning perceptions (e.g. Heaps & Henley, 1999; Laughery et al., 1991; Wogalter & Barlow, 1990). As warnings which explicitly outline the negative consequences have been shown to yield higher hazard perceptions and intended compliance, at the very least the negative warning condition in the present study should have been rated as more hazardous than the control condition. There may be several explanations for the failure to observe differences between warning conditions. The most probable may be that the present manipulations were not robust enough. This issue is discussed further in Chapter 6 along with the implications of this for future research.

An unrelated potential explanation for the lack of a significant main effect of warning condition may concern the power of the study. The observed power for this effect in each of the three analyses ranged from .07 to .11 thus increasing the chances of a type II error (Cohen, 1992). Another potential explanation may concern the fact that a measure of anticipated regret was implemented as a dependant variable. Hetts et al (2000) found that when asked to consider regret in insurance purchase decisions, participants acted to minimise the regret. As participants in the present study were asked to consider the regret they would feel if they did not comply with the warnings they may have been motivated to reduce the potential regret though their compliant intentions. It is possible the very process of asking participants to consider regret may have increased their warning perceptions, thus potentially over-riding any design manipulation effects that may have occurred from the three warning conditions.

Another limitation may arise from scaling and the use of practice stimuli. As recommended by Engen (1972) and as used by other warning researchers (Hellier et al., 2000; Wogalter & Silver, 1990a), participants were given three practice warnings to calibrate their responses (they were shown an example of a high, a medium and a low hazard warning). They were also given an anchored scale on which to response (1 to 7 in the case of intended compliance and anticipated regret, and 1-100 for hazard perception) in keeping with previous research. While these methods are not necessarily a problem for within-subjects designs (employed in Studies Two to Four), the between-subjects nature of the present study may have meant that participants in each condition made their judgements relative to the practice warnings and anchors they were given, thus reducing the variance between groups. Also it is important to note that the positive consequences that were featured on the warnings may not have corresponded with each individual's perception of the positive outcomes of that particular behaviour. In the pilot study there was large variation in participants' responses when asked to list positive consequences of the behaviours. Despite the fact that behaviours with the most frequently reported positive outcomes were selected, it is possible that these outcomes are not the same as those perceived by the participants in the present study.

As previously mentioned the use of extreme groups design can maximise power, however, Preacher et al (2005) maintain that "the primary focus of research should not be to obtain significant *p* values but rather to determine what the data tell us about the phenomena of interest- that is, effect size and practical significance" (p. 181). Indeed the use of such a method can result in inflated effect sizes which render the generalisation of finding to a normal population inappropriate. Therefore the effect sizes obtained in the present study may be a product of the design. While the effects can legitimately be compared across the dependant variables in the present study (i.e. sensation seeking has a larger effect on intended compliance than anticipated regret or hazard perception), they cannot be compared with the previous studies which treat risk-taking as a continuous variable. Another issue is that the allocation of members to each group is arbitrary; participants were assigned to high and low groups based on the variance of the sampled population whereas the classification of high and low sensation seeking groups from the general population (that is what actually constitutes a high or low sensation seeker) is unknown (Preacher et al., 2005). Despite this, the extreme groups design is appropriate for identifying the *presence* of an effect (e.g. Feldt, 1961) and is considered the optimal design for examining interactions like those expected between sensation seeking and the warnings conditions (McClelland & Judd, 1993). As the effect of sensation seeking on warning perception was previously established in Studies One and Four, the use of an extreme groups design in this study is justified, with the recognition that the effect sizes yielded may be artificially high and are not comparable to the general population as a whole.

Therefore, the results of the present study confirm that personal risk-taking propensity levels do predict warning perceptions, and suggest that anticipated regret does mediate this relationship, at least for low sensation seekers. It is not clear at this point however, whether the effects of risk-taking propensity can be reduced through warning design.

Chapter Six

General Discussion

The principle aim of the present research was to establish empirically whether there is a relationship between risk-taking propensity and warning perception. The potential of this relationship had previously been hinted at and a handful of studies have attempted to address this area. However methodological limitations confounded results, as discussed in Chapter Two. A secondary aim was to investigate the potential theoretical underpinnings of any relationship and to investigate how this may be used to inform warning design. Using a primarily psychometric approach, a variety of risk-taking propensity measures were implemented, and compared with responses to warning tasks. The first study investigated the potential relationship between risk-taking propensity and warning perception using an exploratory approach. The second and third studies addressed the domain specific nature of risk-taking and its impact on warning perception. The fourth study explored the underlying theoretical mechanisms behind the effect risk-taking propensity has on warning perception, and the fifth study attempted to minimise those effects through warning design manipulations.

The findings of the five studies will first be discussed and evaluated in terms of their theoretical implications. This will be followed by a discussion of the methodological implications of the present work, followed by some suggested directions for future research.

6.1 Summary of findings and theoretical implications

The findings of the present research will be discussed in terms of the impact that risk-taking propensity measures were found to have on each the warning perception variables separately. A summary in table form can be found in Table 6.1, which outlines significant predictors of intended compliance and hazard perception.

Table 6.1 Summary of significant findings across all studies

Study	Intended Compliance (IC)	Hazard Perception (HP)
One	Sensation Seeking (SS) Impulsivity Behavioural Inhibition Risk Perception	Risk Perception BART
Two	Health & safety RTP > Health & Safety and Recreational IC Recreational RTP > Recreational and Health & Safety IC	Health & Safety RTP > Health & Safety and Recreational HP Ethical RTP > Health & Safety and Recreational HP Recreational RTP > Recreational and Health & Safety HP
Three	Health & Safety RTP > Health & Safety IC Ethical RTP > Health & Safety and Financial IC Financial RTP> Financial IC	Recreational RTP > Financial HP Ethical RTP > Health & Safety HP Health & Safety RTP > Health & Safety HP
Four	Sensation Seeking Behavioural Inhibition CFC scale Positive Prefactual Thinking** Negative Prefactual Thinking Anticipated Regret	CFC Scale Positive Prefactual Thinking Negative Prefactual Thinking Anticipated Regret
	Anticipated Regret was a significant mediator of Sensation Seeking >IC and Behavioural Inhibition >IC	*** Also Sensation Seeking significantly mediated the relationship between Positive Prefactual Thinking and Anticipated Regret*
Five	Sensation Seeking	Sensation Seeking
	Anticipated Regret significant mediator of Sensation Seeking > IC (Low SS)	

RTP (risk taking-propensity)

Intended Compliance

In every study individual differences in risk-taking propensity were found to affect intentions to comply with the warnings presented. In Study One, sensation seeking (in particular the sub-scale thrill & adventure seeking), impulsiveness, behavioural inhibition and risk perception (of general risk) were all found to correlate with intentions to comply with simplistic warnings. Scores which represented high risk-taking propensity on each measure predicted lower intentions to comply with the warnings. Impulsiveness, and the risk perception scale, were the best predictors of intentions to comply with the warnings. Study One established that various measures of risk-taking propensity were related to intentions to comply with simple auditory and visual warnings. However, the effects that the various measures had on participants' intentions to comply with the simple warnings were relatively small.

In Studies Two and Three, domain specific measures of risk-taking were regressed against intentions to comply with domain specific contextual warnings. Study Two revealed that health & safety risk-taking propensity predicted intended compliance with both health & safety and recreational warnings, and recreational risk-taking propensity also predicted intended compliance with recreational and Health & Safety warnings. In Study Three it was found that health & safety risk-taking propensity predicted intended compliance with health & safety warnings only; financial risk-taking predicted intended compliance with financial warnings only; and ethical risk-taking propensity predicted intended compliance with both health & safety and financial warnings. These findings suggest that the relationship between risk-taking propensity and intended compliance is domain specific to a certain extent, and that the size of the effect is larger when using contextual warnings and domain specific measures of risk-taking propensity.

Study Four found that both sensation seeking and behavioural inhibition predicted intentions to comply with warnings. The effect these measures had on participants' intentions was larger in this study (which implemented contextual warnings) compared with the effects the same measures had for the simplistic warnings in Study One. Study Four also revealed that anticipated regret, positive and negative prefactual thinking, and the consideration of future consequences, all relate to intentions to comply with warnings. Study Five employed a quasi-experimental extreme groups design rather than a purely correlational approach. The analysis revealed that participants classed as high sensation seekers held significantly lower intentions to comply with contextual warnings than participants classed as low sensation seekers. The size of the effect was larger than those previously yielded for sensation seeking, although this may have been a product of the design as discussed in Chapter Five.

These findings are consistent with some of the previous work in the area as discussed in Chapter Two, for example studies of self-reported behavioural compliance have found an effect of risk-taking propensity. A very recent study by Carnt, Keay, Willcox, Evans, and Stapleton (2011) found that risk-taking propensity predicted non-compliance with contact lens care instructions. However, they provided little detail about the risk-taking survey implemented. Similarly, Witte and Donohue (2000) found that high sensation seekers were more likely to report that they would not comply with signals at a level crossing. The present results are also partially consistent with Samms and Johnston (2002) who found differences in compliant intentions as a function sensation seeking; however, they found significant differences only for some of the colours tested (those representing medium hazard; magenta, blue and green). Similarly, there have been mixed findings concerning observed behavioural compliance, for example Weaver et al (2003a) observed that high sensation seekers displayed less behavioural compliance with a warning embedded within instructions when the signal word was ‘notice’ than when it was ‘warning’. Also Purswell, Schlegel and Kejriwal (1986) used behavioural compliance and found that scores on a risk-taking attitude questionnaire predicted non-compliant behaviour. Their finding that the experience seeking subscale of the SSS-V was positively related to compliance is at odds with the results of Study One, where experience seeking was not found to relate to hazard perception or intended compliance. However, this study and those described here are subject to serious methodological limitations as discussed in Chapter Two.

Despite a little inconsistency with previous research, the finding that risk-taking propensity predicts intended compliance was replicated in every study presented in this thesis, suggesting that there is a genuine relationship between risk-taking propensity and intentions to comply with warnings. It is also apparent that the relationship is stronger when specific information about the nature of the hazard in question is provided.

Hazard Perception

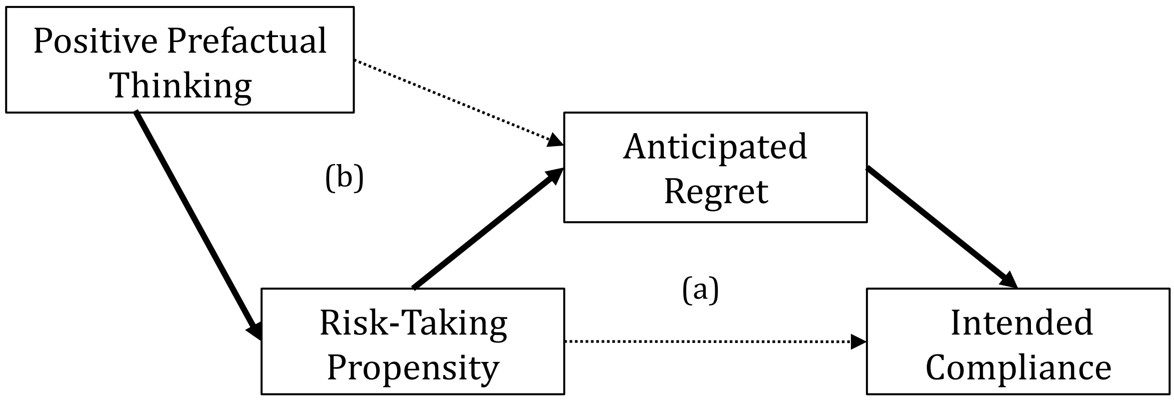
The potential effect of risk-taking propensity on hazard perceptions was less consistent than on intended compliance. In Study One, only scores on the risk perception scale and the BART significantly predicted hazard perception to the simplistic visual and auditory warnings. Study Two revealed that health & safety risk-taking propensity predicted hazard perception of both health & safety and recreational warnings, as did ethical risk-taking propensity. Recreational risk-taking propensity was related to recreational risks only. During Study Three, the manipulation check revealed that results of the analysis for the relationship between risk-taking propensity and hazard perception of congruent warnings were unreliable. Incongruent domains of risk-taking propensity were unaffected by this, and it was found that recreational risk propensity predicted hazard perception of both financial and health & safety warnings, whereas ethical risk propensity predicted hazard perception of health & safety warnings only. Study Four failed to find a significant effect of either sensation seeking or behavioural inhibition on hazard perceptions. However hazard perception was predicted by considerations of future consequences, anticipated regret, and both positive and negative prefactual thinking. Finally, Study Five did reveal that high sensation seekers perceived the warnings as less hazardous than low sensation seekers. However, the use of an extreme groups design may have over-inflated what may have been a negligible effect. It is therefore unclear whether risk-taking propensity reliably affects hazard perceptions. These findings contrast with those of Lion and Meertens (2001) who found that high risk-takers do not seek out as much risk information about potentially hazardous medicines as low risk-takers, implying that their high risk-taking participants perceived less hazard than the low risk-taking participants. In fact Study One did not reveal a relationship between their Risk-Taking Propensity scale and either warning perception variable.

Where relationships were found between hazard perception and measures of risk-taking propensity, the effect sizes were smaller than those found for intention to comply with the warnings. Therefore it can be assumed that although participants with a high risk-taking propensity may not have perceived the warnings to be lower in hazard than those with a low risk-taking propensity, they did report lower compliant intentions. The fact that risk-taking propensity does not consistently influence hazard perception but does influence intentions to comply suggest that the majority of the effect risk-taking propensity has on intended compliance is independent of hazard perception. Although hazard perception is a very well established predictor of intentions to comply with warnings as well as actual compliance (e.g. Friedmann, 1988; Otsubo, 1988; Wogalter et al., 1994a), all models of the warning process reviewed in Chapter One view hazard perception and intentions as separate components. For example in the C-HIP model by Wogalter et al. (1999) attitudes and beliefs (hazard perceptions) and motivations (intended compliance) are assumed to be separate stages in the warning process. As each stage is necessary but not sufficient for compliance (e.g. Laughery, 2006), presumably the reason that risk-taking propensity appears to predict intentions to comply better than hazard perception is because the flow of processing may 'bottleneck' at or before the motivation stage, and therefore does not proceed to the behaviour stage. Similarly, Rogers et al (2000) acknowledged that individual differences (person variables) influence the different stages of their warning model differentially (although they see hazard perception as a factor rather than a core component of their model).

The ISC model by Kalsher & Williams (2006) places perceived threat before the prefactual thought stage which is followed by the intentions stage, suggesting that the warning processing may break down at either of the latter stages. This model shows that recipient characteristics can affect each stage differentially and it appears that this is the case for risk-taking propensity. The findings of Studies Four and Five provide some enlightenment concerning whereabouts in this model the flow of processing is affected by risk-taking propensity, by examining the prefactual thought stage which sits between the perceived threat stage and the intentions stage.

Underlying Mechanisms

Study Four aimed to explore the theoretical underpinnings of the established relationship between risk-taking propensity and intentions to comply with warnings. It was found that both sensation seeking and behavioural inhibition were significantly related to consideration of future consequences, anticipated regret, and positive prefactual thinking. Sensation seeking was not related to negative prefactual thinking, however, the relationship between behavioural inhibition and negative prefactual thinking just missed significance. Studies Four and Five revealed that anticipated regret partially mediated the relationship between both risk propensity measures (sensation seeking and behavioural inhibition) and intentions to comply with the warnings. This was not the case for prefactual thinking or consideration of future consequences. However, it was also found that sensation seeking mediated the relationship between prefactual thinking and intended compliance (rather than vice versa as originally expected). See Figure 6.1 for the theoretical model of the relationships which were generated by the present work. In the diagram, the mediatory relationship (a) has been fairly well established here. As formerly mentioned the mediatory influence of anticipated regret was replicated for both sensation seeking and behavioural inhibition in Study four.



Note: the arrows in bold represent the significant indirect relationships between variables, whereas the dashed line represent the non-significant direct relationships.

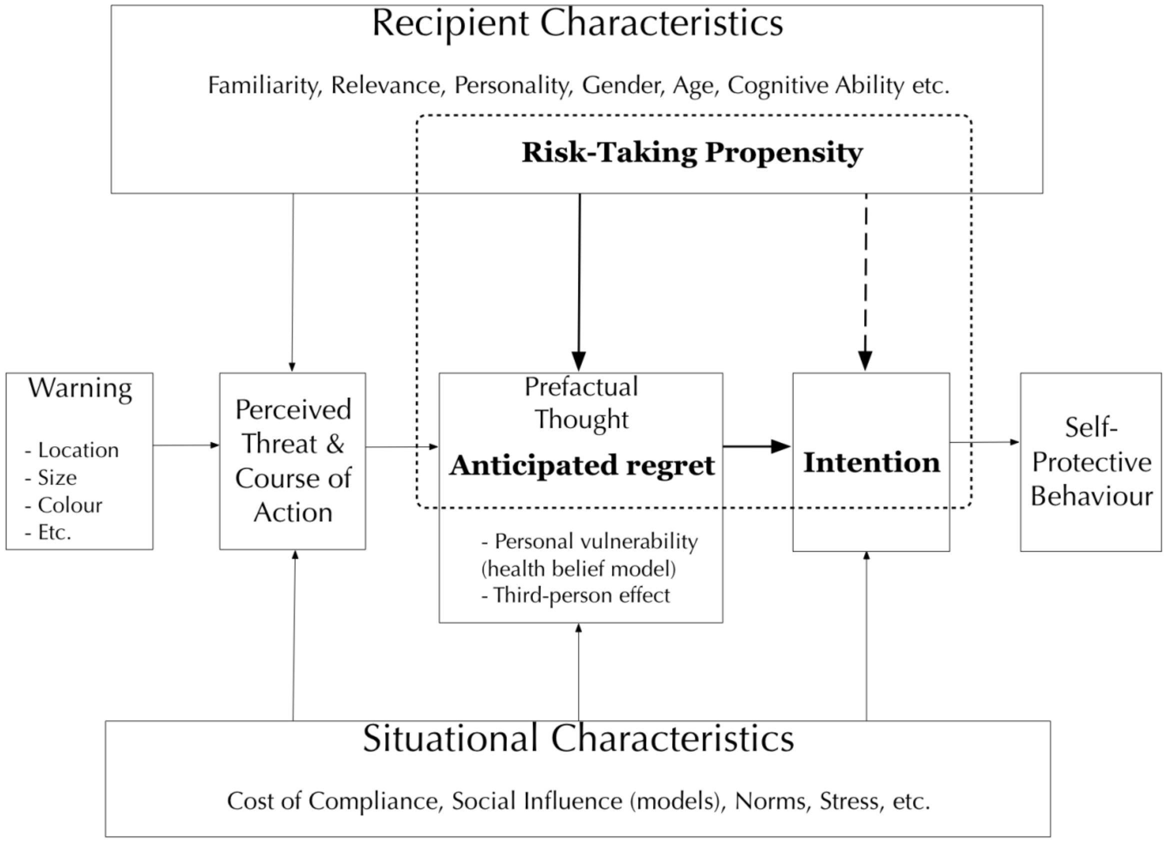
Figure 6.1 The proposed mediatory relationships between risk-taking propensity and intended compliance.

The same relationship was replicated in Study Five, for low sensations seekers; however the Sobel test very narrowly missed significance for the high sensation seeking group, meaning that anticipated regret was not a significant mediator for high sensation seekers. The effect of anticipated regret appears to be more pronounced for low sensation seekers compared with high sensation seekers. It may also mean that the relationships that were observed throughout this thesis are driven by the effects of anticipated regret in low risk-takers.

It is clear that on some level, anticipated regret may be assumed to mediate the relationship between risk-taking propensity and intended compliance. There is less confidence surrounding the mediatory relationship (b) in Figure 6.1. First, this relationship was apparent for sensation seeking but narrowly missed significance for behavioural inhibition. Second, there were methodological issues surrounding the prefactual measurement (discussed at length in Chapter Four) which may have limited its validity. Third, these findings did not arise from theory but instead were data driven. Therefore further investigation is required to increase confidence in this section of the model.

Nevertheless the finding that anticipated regret plays a mediatory role between risk-taking propensity and intentions to comply, and that prefactual thinking affects intended compliance are both consistent with the ISC model of the warning process (Kalsher & Williams, 2006). This is the only model to incorporate directly prefactual thought and anticipated regret. Studies Four and Five confirmed that prefactual thinking and anticipated regret do play a role in the warning process and that anticipated regret in particular is associated with individual differences in recipient characteristics. In fact the mediatory relationship (a) in Figure 6.1 can be directly incorporated into the ISC model, as illustrated in Figure 6.2. The findings of the current thesis suggest that risk-taking propensity is a recipient characteristic that does not influence the perceived threat stage (as there was little effect on hazard perception), but rather impacts indirectly on the intentions stage, through its influence on the prefactual thought stage.

It is important to note that the ISC model was not published in a peer reviewed journal, nor has it been verified with research findings, therefore it must be treated with caution. For example in this model anticipated regret is considered a type of prefactual thought; however, mental simulation research (see Chapter Four) suggests that the two are different, but associated, components.



Note: the arrows in bold represent the significant indirect relationships between variables, whereas the dashed line represent the non-significant direct relationships.

Figure 6.2Kalsher& Williams (2006) ISC model modified to include the findings of the current work

This latter notion is supported by the findings of Study Four, which found that prefactual thinking and anticipated regret impacted differentially on risk-taking propensity and warning perceptions. Zeelenberg and Pieters (2006) implied that regret is a product of counterfactual mental simulation and as such anticipated regret may be considered to be a product of prefactual thinking. If one simulates regrettable outcomes of a risky behaviour, this is likely to lead to the anticipation of regret. However, this may not necessarily be the case; it is possible that people experience anticipated regret as a 'gut' feeling which leads them to simulate negative prefactual outcomes.

Implication for risk-taking research: Risk vs. Reward

The studies provide insight into the underlying psychological mechanisms relating personality, risky behaviour, and warning perceptions. Not only do the findings have implications for warning design and hazard control but they provide some further insight into the theoretical basis of risk-taking behaviour in general. Taken together, the current findings suggest that high risk-takers do not necessarily perceive risks differently from low risk-takers (as there was little effect of risk-taking propensity on hazard perception and no effect on negative prefactual thinking), but do differ in their intentions and actions.

There is a belief within some of the risk-taking literature that individuals (in particular adolescents) engage in risky behaviour because they underestimate the level risk involved (Arnett, 2000; Franken et al., 1992; Romer & Jamieson, 2001). However there are mixed findings within this area as discussed in Chapter One, which may be explained by the effect of familiarity or experience with a risk; as previously mentioned risk perceptions decrease with benign experience. Horvath and Zuckerman (1993) found that engagement in risky behaviour subsequently reduced risk perception. Similarly, Wilson and Jonah (1985) found participation in drink driving led to lower perception of the risk of being arrested. For example, the more that you drive home drunk and do not experience any adverse consequences the safer you will perceive drink driving to be. Where high risk-takers are found to have lower risk perceptions than low risk-takers, it may be the case that previous benign (or even rewarding) experience with the risk has led to low risk perceptions, rather than the possibility that high risk-takers are predisposed to greatly under appreciate risks. Indeed Cook and Bellis (2001) found that although high risk-takers have lower perceptions of risk, they were more accurate at judging risk numerically, suggesting that such people are aware of the risks of their behaviours but choose to engage in them anyway.

The findings of Study Four suggest that high risk-takers do not differ from low risk-takers in the number of negative consequences they generated in relation to the hazards depicted in the warnings. This suggests that the high risk-takers did not underestimate the risks associated with the hazards, but instead may overestimate the positive consequences or the benefits they would receive from engaging in the risky behaviours they were being warned against. The idea that risk-takers do not underestimate risks, but overestimate benefits, has received some endorsement within the literature. The expectation of benefits has been found to better predict self-reported and actual risky behaviour (Fromme, Katz, & Rivet, 1997; Hanoch et al., 2006; Ott, Millstein, Ofner, & Halpern-Felsher, 2006; Urbán, Kökönyei, & Demetrovics, 2008) and decision making task like the IGT (Cauffman et al., 2010) than does the expectation of negative consequences. Indeed, Maslowsky, Buvinger, Keating, Steinberg, and Cauffman (2011) found that the extent to which adolescents perceive the benefits of a range of risky behaviours to *outweigh* the potential costs partially meditated the relationship between their sensation seeking scores and their engagement in the risky behaviours. Similarly, Weber et al (2002) argued that risk attitude is explained by risk perception and expected benefits. It is important to note here that when replicating Weber's analysis in Studies Two and Three, it was apparent that the extent to which risk perception and expected benefits influence risk-taking propensity differed across the domains of risk. The fact that risk-taking propensity was not consistently related to hazard perception in the current work supports the notion that risk-takers may not be biased in terms of risk perceptions. Taken together with the finding that risk-taking was related to positive prefactual thinking (but not negative), this further supports the notion that risk-takers see the rewards as outweighing the risks of risky behaviour. It appears that high risk-takers do choose to accept risks rather than perceive them incorrectly.

Implications for warning design; the role of anticipated regret

Anticipated regret was found to mediate the effect of risk-taking propensity on intended compliance almost totally. Not only is this finding novel in respect to establishing risk-taking propensity as an individual difference in the warning process, it also has implications for warning research in general. It may be the case that the differences observed for risk-taking measures are manifestations of differences in anticipated regret. Study Four revealed that anticipated regret was the best predictor of hazard perceptions and intentions to comply with warnings. Indeed anticipated regret has been found to be an important factor in motivating people to perform precautionary behaviour in relation to fear appeals (e.g. Richard et al., 1996; Smerecnik & Ruiter, 2010). It is possible that anticipated regret may be a better predictor of compliance with warnings than hazard perception. As mentioned in

Chapter Four, regret aversion can lead to risk-aversion or risk-seeking depending on the context. Zeelenberg et al. (1996) presented participants with both a risky gamble and a safe gamble and primed participants to experience anticipated regret by allowing them to learn the outcome of the alternative decision after they have made their selection. When the option to learn the outcome was offered with the risky gamble, participants performed in a risk-averse manner; however, when the option to learn the outcome was offered with the safe gamble, participants were more risk-seeking. This may be applied to the warning process. If an individual anticipates that they will regret complying with a warning then they will be less likely to comply. Anticipated regret may take into account the benefits of non-compliance better (and therefore may be more predictive of intended compliance) than hazard perception. An individual may anticipate that they will regret complying with a warning if they will miss out on a rewarding or beneficial experience even if they correctly perceive the hazard involved. Kalsher and Williams (2006) have suggested anticipated regret to be an important factor in the warning process, however, this idea is relatively overlooked within the warnings literature. The findings of the current thesis suggest that anticipated regret may be a fruitful line of inquiry for warning researchers.

Increasing Risk-Takers' Compliant Intentions

Study Five attempted to minimise the effect that risk-taking propensity has on intentions to comply with warnings. As the results of Study Four suggested, anticipated regret mediates this relationship, warning stimuli designed to minimise regret are likely to be successful in increasing high risk-takers' intentions to comply. Sensation seeking was found to mediate the relationship between positive prefactual thinking and intended compliance, therefore two possible ways to minimise the discrepancy between high and low risk-takers' compliant intentions were explored. One approach was to implement warnings which emphasised how high risk-takers are not going to get the rewards they desire. Alternatively, the other approach aimed to increase the number of negative prefactuals generated so that the risk of negative consequences outweighs the positive consequences of non-compliance for the high risk-taker. Intended compliance to these 'positive' and 'negative' warnings was compared with basic control warnings in Study Five. However no effect of warning condition was found on the relationship between risk-taking propensity and intended compliance. This finding gives rise to a number of explanations. One conclusion is that warning variable manipulations in general are not robust enough to change high risk-takers' intentions. Another concerns the implementation of anticipated regret as a dependant variable, which may have affected responses. Previous research has found that directly priming participants to anticipate regret from a future outcome can increase compliant intentions and precautionary behaviour (e.g. Hetts et al., 2000). Therefore asking participants to report how much regret they anticipated experiencing from non-compliant behaviour may have primed them to anticipate greater levels of regret than they would otherwise have anticipated. It is possible that the effects of this priming may be robust enough to override any effects of the warning condition. However, a more probable explanation is that the stimuli manipulations themselves were not successful. Contrary to expectations there was no effect of any warning condition. This findings is also at odds with the warning literature which suggests at the very least the negative warnings should yield higher compliant intentions (and hazard perceptions) than the basic control warnings (e.g. Heaps & Henley, 1999; Laughery et al., 1991; Wogalter & Barlow, 1990). There were methodological limitations (discussed further in the following methodological implications section) which suggest this is likely to be the case. Alternative approaches to manipulating anticipated regret in warning design will be considered in the discussion of future research. Therefore it is still possible that other warning design manipulations may be an effective way of decreasing risk-takers' intentions to comply despite the fact that the present stimulus manipulation was not effective.

6.2 Methodological Implications

The studies presented in this thesis have addressed some of the methodological problems observed in previous studies that have examined risk-taking propensity in relation to warnings. However, there are still limitations which restrict the current findings. Many of the specific methodological issues have been discussed within each chapter; however, there are some broader issues which affect several of the studies, which are discussed here.

Warning perception

The main point to consider is that compliant intentions were measured throughout, rather than actual behavioural compliance. As described in the ISC and C-HIP models (Kalsher & Williams, 2006; Wogalter et al., 1999) intentions are a separate component of the warning process from actual behaviour. The theory of planned behaviour has long recognised the intention–behaviour gap (e.g. Fife-Schaw, Sheeran, & Norman, 2007; Sheeran, 2002) and there is a multitude of factors which may prevent intentions translating into actions (see Sheeran, for a review). Intended compliance was used as a dependant variable in the present body of work as it is seen as a close indicator of actual compliance (Wogalter & Dingus, 1999). In the C-HIP (Wogalter et al., 1999) and the ISC (Kalsher & Williams) models, intentions are the penultimate stage of the warning process, with behaviour being the final stage. Although intentions provide an indication of likely behavioural compliance, when assessing the current findings it is important to consider that the findings may not apply to actual warning compliance in real life situations. The relationship between risk-taking propensity and warning observed compliance should be confirmed before solid recommendations can be made.

Context Specificity

A critical methodological implication that deserves consideration is the way in which warning perception variables were aggregated across stimuli rather than examined at an individual level. During the current work, warning perception averaged in order to obtain a general indication of the participants' compliance nature and tendency for hazard perception. As demonstrated in the models of the warnings process (in particular Edworthy, 1998), situational factors unique to the hazard in question affect warning perceptions and compliance with associated warnings. It is crucial to consider the individual aspects of each situation, for example, in Study Four it was apparent that there were large differences in the number of positive prefactuals generated for each warning. There were four warnings in particular to which participants produced the most prefactuals. For example, for the warning with the context 'going down a ski run that is beyond your ability', participants produced nearly twice as many positive prefactuals as for the other three warnings used. Indeed, some hazardous behaviours simply have more positive (or negative) consequences than others. Examining each warning stimulus separately may provide a richer understanding of the nature of the relationship between risk-taking propensity and warning perception. As warning compliance is highly context specific, with a multitude of important factors, more emphasis on the particulars of individual hazards might be considered to a greater extent than has been done in this thesis.

Risk-Taking Propensity

There are also limitations concerning the approaches taken when measuring risk-taking propensity. One particular issue with using self-reported intentions with risk-takers is that the high risk-takers may want to present themselves in a non-conformist manner. Individuals who feel they are high risk-takers may want to express themselves as rebellious and wish to appear not to follow the norms of society. Indeed sensation seeking has been associated with non-conformist attitudes (Zuckerman & Link, 1968). Such people may be more reactant in nature and when confronted with a warning which they feel infringes on their freedom, and they may feel that indicating non-compliance re-establishes their freedom (see Miron & Brehm, 2006). It may be the case that in a safe, 'trivial' psychology study high risk-takers are compelled to report higher non-compliance with the warnings than they may actually display in real life situations. Similarly, low risk-takers may display opposing demand characteristics, as discussed in Chapter Three such people may want to present themselves in a socially desirable way.

An issue with the psychometric approach to risk is that it implicitly (and sometimes explicitly) assumes that there is a stable and generalised tendency to appraise risk and engage in risky behaviour in general. Whereas there is a growing body of research (outlined previously) which argues that risk-taking propensity is domain specific (Blais & Weber, 2006; Weber et al., 2002). As there may be such differences between domains of risk-taking propensity, trait measures may overestimate the usefulness of identifying a disposition for general risk seeking or avoidance to account for such differences. This problem was overcome in the present thesis by demonstrating the effect of risk-taking on warning perceptions with both general and domain specific measures. While there is evidence that risk-taking propensity can be domain specific, the idea that a general tendency for risk perception may still be of importance is also argued. The two concepts are not necessary mutually exclusive. For example, risk-taking propensity has been found to be both general and domain specific. Zaleskiewicz (2001) argues that risk seeking can be divided into two forms, stimulation (SRT; where the motivation is the arousal of the risk 'no matter what the risk') and instrumental (IRT; where the motivation is the long term goal or achievement associated with the specific risk). He examined these two forms of risk-taking propensity in relation to domain specific risk-taking (note this study precedes the construction of the DOSPERT). It was found that SRT positively correlated to health, ethical, and recreational risks as well as gambling, but not to financial investment risks. IRT was correlated positively only with investment, gambling and social risk, but not related to any other domain of risk. Nicholson, Soane, Fenton-O'Creevy, and Willman (2005) also describe both specific and general risk-takers; therefore there may be benefit in perusing both approaches. That said, given the potentially highly context specific nature of warning compliance described previously, it is also likely that risk-taking itself is highly context specific.

Sensation Seeking

The main focus of the present work was on sensation seeking as a measure of risk-taking propensity; however, the scale has come under some scrutiny in recent years. As the scale is not considered a direct measure of risk-taking behaviour, focusing on the SSS-V as a propensity measure excludes other motives for risky behaviour (Llewellyn, 2008). Indeed the reasons why one might undertake a certain risk may vary considerably across individuals and situations. For example, a normally very low risk-taker might engage in very high levels of risk under extreme circumstances, for example when their offspring are in danger. Again, this highlights the context specific nature of risk-taking. Conversely, the SSS-V had been criticised for its tautologous nature as some of the items refer to actual risk-taking behaviours which is often a confound in studies where dependant variables are similar risk-taking behaviours (Llewellyn, 2008; Zuckerman, 2007). As the dependant variables in the present work were warning perception variables, that is, reactions to messages persuading restraint from engagement in risky behaviours rather than direct measures of risky behaviour, and those behaviours were not replicated directly in the warnings, these criticisms may have less impact on the present findings than they might on other studies.

Variables not considered

As both risk-taking behaviour and the warning process are complex and multifaceted, there may be many variables that were not considered directly or controlled for which may limit the present work. One obvious variable which affects both warning compliance and risk-taking behaviour is perceived control. People perceive hazardous behaviours to be safer when they are controllable (Weinstein, 1984). Indeed Friedmann (1988) found non-compliant participants reported that they believed they could control adverse consequences when interacting with hazards. Also anticipated regret is implicated here. Smerecnik and Ruiter (2010) found that anticipated regret mediated the relationship between the extent to which people believe they can control risks and precautionary intentions. While many researchers treat control as one dimension, Nordgren, van der Pligt and van Harreveld (2007) found evidence that 'control' can be unpacked into two district facets, which are command over the outcome of a risk (control) and command over the exposure to the risk (volition). It was found that perceptions of control were related to decreased risk perception, whereas increased perceptions of volitional control were related to increased risk perceptions. Furthermore, consistent with Smerecnik and Ruiter (2010), anticipated regret was found to mediate the relationship between volition and perceived risk (Nordgren et al., 2007). While all the risks depicted in the warnings stimuli in this thesis were voluntary, the degree of volition was not assessed. Also Rosenbloom (2003) found that high sensation seekers tend to overestimate their control over risky situations. Therefore measuring variables of perceived control in future may increase the understanding of the relationship between risk-taking propensity, anticipated regret, and warning perception.

Prior experience with a hazard or risk has a large influence over how an individual will perceive and engage with it. This has been well established within the warning literature as discussed in Chapter One (Godfrey et al., 1983; Godfrey & Laughery, 1984; Goldhaber & deTurck, 1988; Leonard et al., 1989; Otsubo, 1988; Wogalter et al., 1995a; Wogalter et al., 1991). Benign experience decreases hazard/risk perception and, naturally, non-benign experience increases people's perceived probability of adverse outcomes, therefore familiarity, including vicarious experience (Leonard et al., 1986) may have been an important variable to consider in the relationship between risk-taking propensity and warning perception. Naturally, if you injure yourself while behaving riskily or non-compliantly, you will behave more cautiously next time you are in a similar situation. However Wogalter et al. (1991) found that familiarity explained little variance in compliance above that which was explained by its effect on hazard perception. As risk-taking propensity in the present thesis was primarily related to intended compliance and not hazard perception, the effect of familiarity and experience may have little effect on the relationship between risk-taking propensity and intended compliance. However, this seems counterintuitive therefore it is important to establish the potential interplay between such variables in future research. At the very least, prior experience with a hazard should be controlled for in future research.

Another factor concerning the risks depicted in the warnings which it was not possible to address was whether non-compliance leads to long or short term consequences. Study Four revealed that scores on the consideration of future consequences scale (Strathman et al., 1994) were related to risk-taking propensity, negative prefactual thinking, and warning perception. As this scale measure the extent to which one considers the long term outcomes of behaviour, it is likely that assessing the extent to which the outcomes of the hazard in question are immediate or delayed may have implications for the present findings. Indeed, risks that have delayed negative consequences are considered less risky by some than those with immediate outcomes (e.g. Fischoff, Slovic, Lichtenstein, Read, & Combs, 1987). The effect of risk-taking propensity on intended compliance in the present thesis was not large, therefore other variables may explain more of the variance in intentions to comply with warnings.

Mediation

During Studies Four and Five, mediational analysis was performed following recommendations (Baron & Kenny, 1986; Preacher & Leonardelli, 2010). There appears to be some disparity in the literature as to what constitutes partial and total mediation. One school of thought considers complete mediation to occur only when the addition of the mediator variable completely reduces the effect of the independent variable (Baron & Kenny, 1986; Kenny, 2011), so that the beta value is 0. The other considers total mediation to occur when the mediator merely reduces the effect of the independent variable so that it is no longer significant (as used by Nordgren et al., 2007 for example). The approach taken in this thesis is that of the former school of thought as it is more conservative and may avoid making unfounded claims about the nature or mediatory relationships. For example in Study Four anticipated regret was considered to partially mediate the relationship between sensation seeking and intended compliance, as the effect became non-significant and the beta value was reduced to -.01. The latter approach would consider this complete mediation and this may unwittingly lead to underestimation of other potential factors. However, the conservative approach adopted may mean that the role of anticipated regret in the current findings was slightly underplayed. However, the choice of the conservative approach may increase confidence in the model as it shows that anticipated regret does at least partially (if not fully) mediate the relationship between risk-taking propensity and intended compliance. As the relationship was considered partial here, the unconsidered variables described may explain more variation in compliant intentions.

Anticipated Regret Stimuli Manipulation

As mentioned previously, the findings of Study Five contrast with previous research, which has found warning perception/compliance to be higher when negative consequences are emphasised. The failure to replicate established findings may have arisen from the way that the negative consequences were operationalised. In the negative condition the warning was manipulated by taking the basic consequence of non-compliance and expanding on it by outlining two negative consequences. In doing so the focus was on the number of negative outcomes, in order to stimulate negative prefactual thinking in the participant. However, the actual explicitness of the wording of each of those two outcomes was not considered. For example, the warning featured in Figure 5.1 regarding the dangers of skiing down a slope that is beyond the receiver's ability informs participants that they 'may have a serious accident leading to injury or death'. The wording used could have been more explicit, for example 'leading to broken bones or a painful death' which may imply higher severity to the receiver. Also the warnings in the positive condition may not have adequately negated the benefits of non-compliance. Returning to the example of the warnings depicted in Figure 5.1, the positive condition warned participants that a serious accident would mean that they 'would no longer be able to enjoy the challenge or fun of skiing' in the future. Here the positive outcomes are being stated but perhaps not effectively negated. The warnings did not explain that the behaviour in question was not going to be challenging or fun, which may have been a more effective approach. The implications of this for future research will be discussed in the next section.

6.3 Future Directions

The methodological limitations of the present work have highlighted two foremost implications for future research; the need to establish the effect of risk-taking propensity on actual compliant behaviour, and the continuation of the search for ways in which warnings can be designed to minimise high risk-takers' reluctance to comply with warnings.

Primarily, as the focus of the present work was on warning perceptions only, it is imperative that the findings are replicated with behavioural compliance as a dependant variable. Behavioural compliance is often difficult to observe without endangering participants, especially in relation to individual differences. Also there are ethical considerations as participants may be subject to harm from real hazards. Therefore intended compliance was chosen in the present thesis. Naturally, intentions do not necessarily translate into action. Indeed, many theories of motivation and action, for example the theory of planned behaviour (Ajzen, 1991), suggest that the path between intentions and behaviour may be disrupted by many factors such as behavioural control (perceived or actual).

Although actual behavioural compliance is rarely implemented in warning literature (Smith-Jackson & Wogalter, 2006) popular methods include naturalistic observations (Shaver & Braun, 2000), simulations (Lee, McGehee, Brown, & Reyes, 2002) and laboratory demonstrations where participants are required to undertake a practical but potential hazardous task, for example mixing chemicals (Weaver et al., 2003a) or woodwork (Weaver et al., 2003b). It may prove difficult to measure participants' risk-taking propensity in naturalistic observations and it could be argued that participant may not react in simulations exactly as they would in real-life situations. Therefore, the laboratory task approach may be a practical and valid approach in investigating this further. For example, a task which requires participants to mix a variety of chemicals is a relatively easy way to collect compliant observations, measure risk-taking propensity for comparison, and manipulate the warning presented in an internally valid manner. Indeed Weaver et al. (2003a) took this approach and measured sensation seeking. However, as discussed in Chapter Two, there were methodological limitations that restricted the power and validity of that study. Future research should implement a similar task to confirm the relationship between risk-taking propensity and behavioural compliance in a controlled setting. In doing so the participants' previous experience with the hazard should be considered and controlled.

As previously discussed, methodological limitations in the way that the warnings in Study Five were designed may have limited their success in minimising the discrepancy between high and low risk-takers. If the findings of the current research are to improve safety warning that reduce high risk-takers, potential non-compliance must be investigated. One way to do this is to ask the receiver to consider the regret they may feel directly, as this has been shown to be effective in theoretical studies of mental simulation (Hetts et al., 2000). As mentioned in Chapter Four, it is not easy to incorporate this into a warning label a credible manner. A better approach may be to address the methodological problems discussed, and make the negative warnings more verbally explicit as is common in the warnings literature (e.g. Edworthy et al., 2001; Laughery et al., 1991; Laughery & Smith, 2006; Wogalter & Barlow, 1990). For example 'drinking while pregnant harms your baby' is less explicit than 'if you drink alcohol excessively while pregnant your baby will be born with debilitating mental and physical problems and may need institutionalisation'. Alternatively, positive prefactual generation was higher in high risk-takers, thus exploring ways to negate properly the beneficial outcomes in the positive warning condition by informing participants that they will not receive the rewarding outcomes they desire might be a useful direction to take. However, for this to be effective, it must be done in a believable manner as trust in the warning message is a known factor in the warning process (Horst et al., 1986). For example, if a warning message informs adolescents that binge drinking is neither fun nor socially rewarding, and the receiver has found the opposite from experience, then their trust in the message it likely to be reduced. Therefore it is important to consider ways in which positive outcomes of hazardous behaviour can be validly negated.

Another means of increasing anticipated regret may be to manipulate the extent to which the agent is depicted as responsible for the negative consequences. People experience more regret when they believe that they could have prevented a negative outcome (Gilovich & Medvec, 1995), therefore they should anticipate more regret if they consider that they will be personally responsible for future negative outcomes. How the hazard is mitigated is also relevant here as there is evidence that people regret inactions more than actions (Gilovich & Medvec, 1995; Zeelenberg, Van den Bos, Van Dijk, & Pieters). Warnings which prime anticipated regret by implying personal responsibility of potential negative consequences may be effective in increasing anticipated regret and in turn intended compliance (as well as actual compliance) in high risk-takers. It is also important to consider the related role of control here. Perceptions of personal responsibility are likely be related to the degree of control the receiver has over the hazard depicted in the warning. As discussed, control may be a very important factor in the relationship between risk-taking propensity and compliance with warnings. Indeed high risk-takers are thought to believe they have higher control over risks (e.g. Rosenbloom, 2003) which may limit their experience of anticipated regret in relations to warnings. Therefore, control should be considered and explored as another potential mediator, and if successful, this potential relationship might give rise to another way of increasing compliance. Manipulating the extent to which the receiver is able to control the negative consequences may be an effective way of reducing high risk-takers' optimistic bias and increase compliance.

6.4 Conclusions

Taken together the findings of the thesis clearly demonstrate that risk-taking propensity can affect warning perceptions, in particular intentions to comply with warnings. High risk-takers hold lower intentions to comply with warnings of various types than low risk-takers and it is suggested that this effect is partially mediated by anticipated regret. The present research has potentially fruitful and important practical implications. As individuals with a high risk-taking propensity are found to have lower intentions to comply, many people may be putting themselves in unnecessary danger in a range of situations. The role of a warning is ideally to encourage safe behaviour in the presence of a hazard. It should do so by calibrating the receiver's decision whether or not to engage with a particular hazard in a safe manner (e.g. Edworthy, 1998). It may be possible to design warnings to better calibrate high risk-takers' decisions, thus encouraging them to behave more safely in the presence of hazards. High risk-takers are arguably in greater need of appropriately calibrated warnings, as they are more likely to be in hazardous situations than low risk-takers as a result of their vocational and lifestyle choices (Zaleski, 1984). There is evidence that high risk-takers do cluster in certain occupations and situation, therefore warnings tailored to high risk-takers may be implemented in such specific situations. Designing warnings that are effect for risk-takers may be of particular importance in countries where there is a culture of liability claims. Meingast, Laughery, Laughery and Lovvoll (1999) found that in scenarios where there is a warning present and an accident occurs, the individual involved is assumed to be more responsible for the accident if they are a high risk-taker even when the scenarios are otherwise identical. It is suggested that the public perceive high risk-takers to be more liable than low risk-takers in hazardous situations. Therefore warnings that increase compliance in this group are of great importance.

Appendices

All appendices are numbered in line with the chapter to which their contents refer

Chapter 2 Appendices

Appendix 2A The relative predicted hazard levels of each iconic variable combination

Auditory Stimuli

Freq (Hz)	IpI (ms)	Vol (-dB)	Freq Hazard	IpI Hazard	Vol Hazard	Predicted Hazard
800	0	0	3	3	3	9
800	250	0	3	2	3	8
800	500	0	3	1	3	7
800	0	5	3	3	2	8
800	250	5	3	2	2	7
800	500	5	3	1	2	6
800	0	10	3	3	1	7
800	250	10	3	2	1	6
800	500	10	3	1	1	5
500	0	0	2	3	3	8
500	250	0	2	2	3	7
500	500	0	2	1	3	6
500	0	5	2	3	2	7
500	250	5	2	2	2	6
500	500	5	2	1	2	5
500	0	10	2	3	1	6
500	250	10	2	2	1	5
500	500	10	2	1	1	4
200	0	0	1	3	3	7
200	250	0	1	2	3	6
200	500	0	1	1	3	5
200	0	5	1	3	2	6
200	250	5	1	2	2	5
200	500	5	1	1	2	4
200	0	10	1	3	1	5
200	250	10	1	2	1	4
200	500	10	1	1	1	3

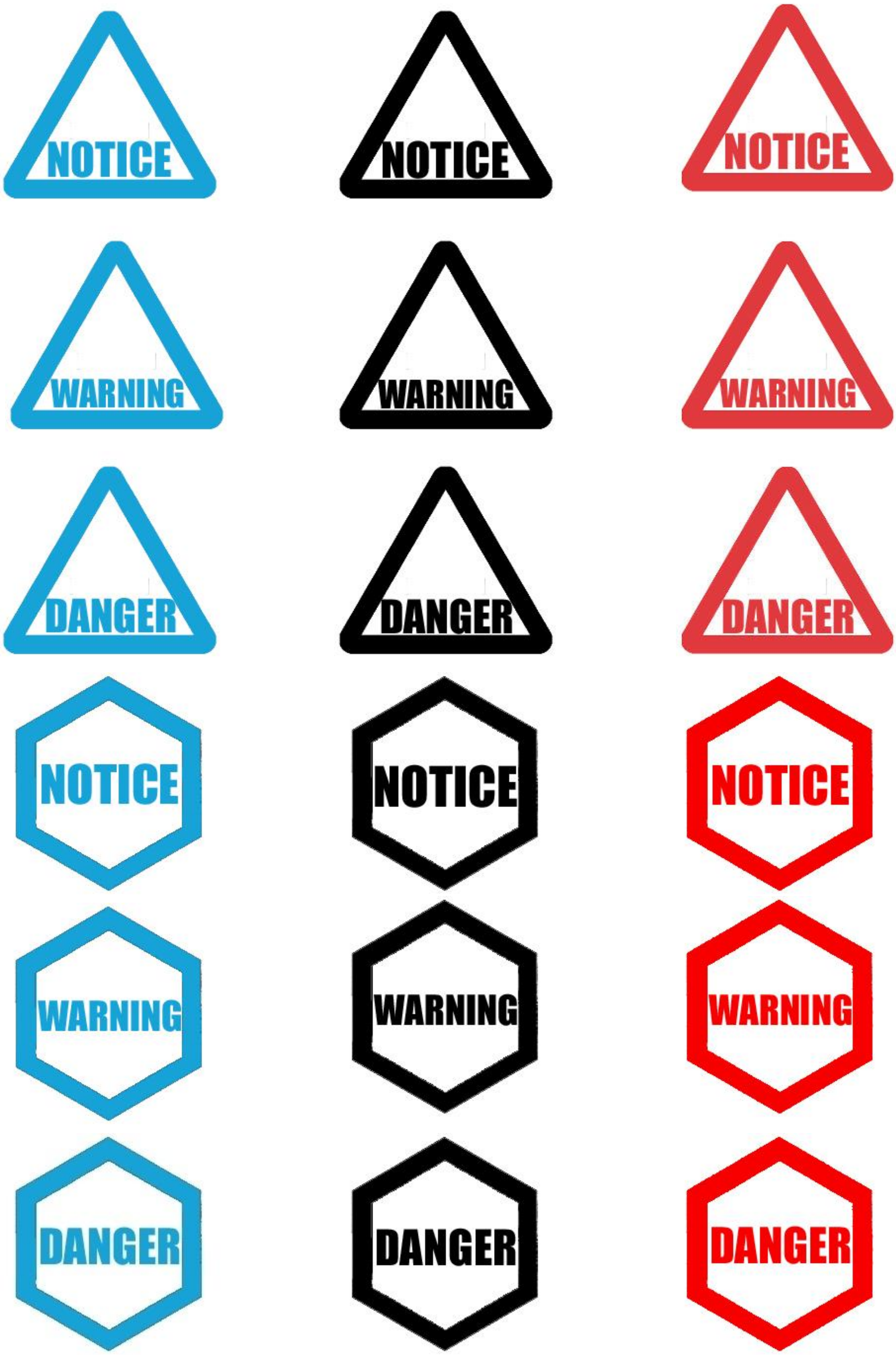
Appendix 2A continued

Visual stimuli

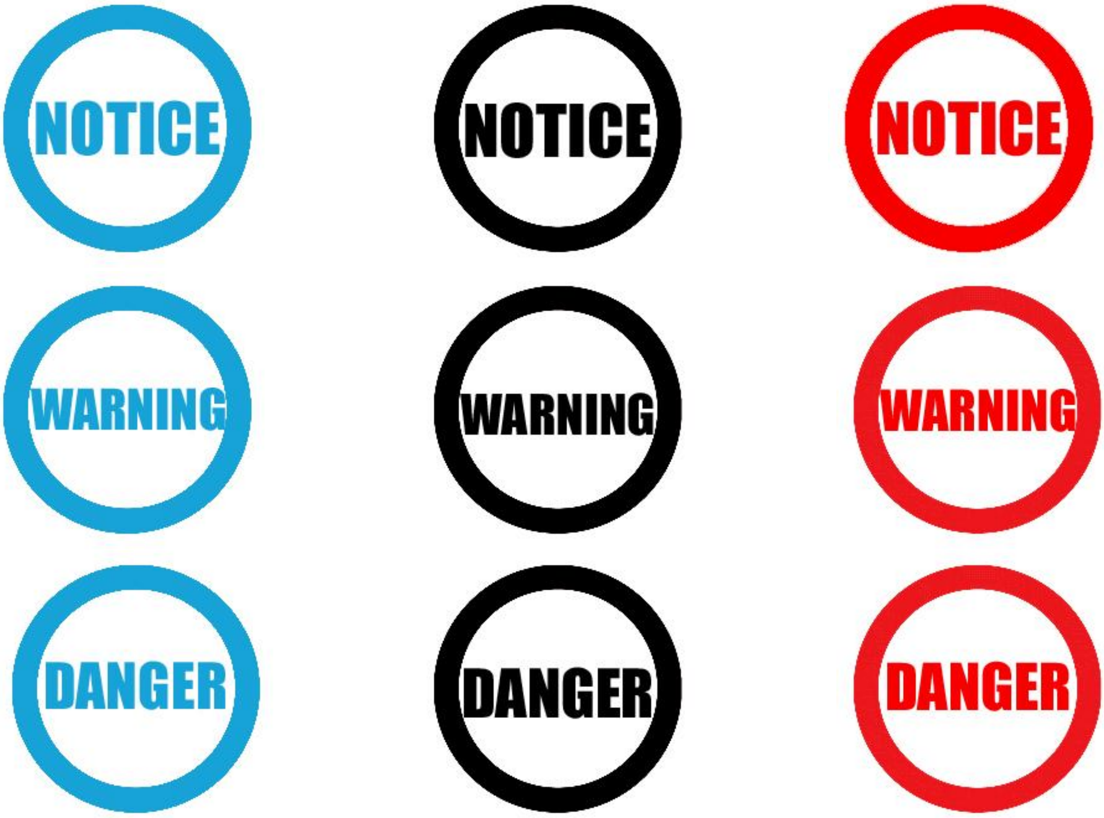
Shape	Colour	Word	Shape Hazard	Colour Hazard	Word Hazard	Predicted Hazard
Triangle	red	Danger	3	3	3	9
Triangle	black	Danger	3	2	3	8
Triangle	blue	Danger	3	1	3	7
Triangle	red	Warning	3	3	2	8
Triangle	black	Warning	3	2	2	7
Triangle	blue	Warning	3	1	2	6
Triangle	red	Notice	3	3	1	7
Triangle	black	Notice	3	2	1	6
Triangle	blue	Notice	3	1	1	5
hexagon	red	Danger	2	3	3	8
hexagon	black	Danger	2	2	3	7
hexagon	blue	Danger	2	1	3	6
hexagon	red	Warning	2	3	2	7
hexagon	black	Warning	2	2	2	6
hexagon	blue	Warning	2	1	2	5
hexagon	red	Notice	2	3	1	6
hexagon	black	Notice	2	2	1	5
hexagon	blue	Notice	2	1	1	4
circle	red	Danger	1	3	3	7
circle	black	Danger	1	2	3	6
circle	blue	Danger	1	1	3	5
circle	red	Warning	1	3	2	6
circle	black	Warning	1	2	2	5
circle	blue	Warning	1	1	2	4
circle	red	Notice	1	3	1	5
circle	black	Notice	1	2	1	4
circle	blue	Notice	1	1	1	3

Appendix 2B The Visual Warning Stimuli

Experimental Stimuli

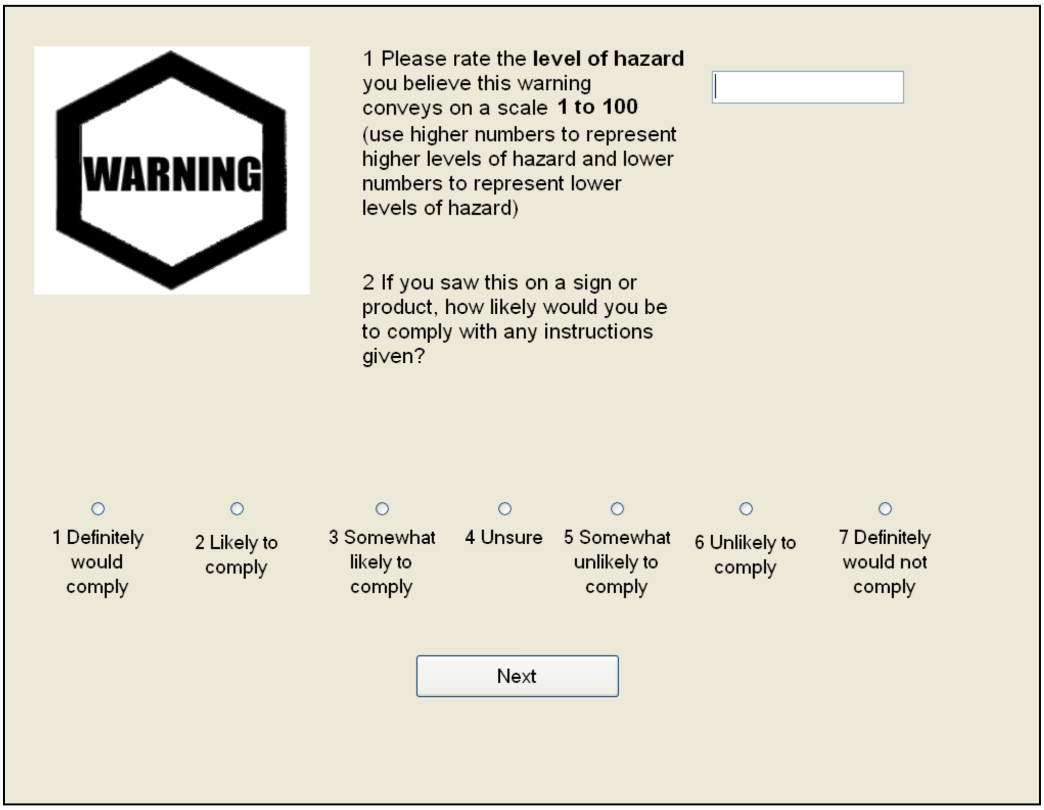


Appendix 2B continued



Practice Stimuli

Appendix 2C An example screen shot taken from the warning task



Appendix 2D The Sensation Seeking Scale

Scale has been removed due to Copyright restrictions

Appendix 2E The BIS/BAS scale
(Carver & White, 1994)

Scale has been removed due to Copyright restrictions

Appendix 2G Risk Behaviour Scale

Below is a list of 12 activities, please indicate how often you have engaged in the following behaviours in the past two years? Please select the number you think is appropriate

In the past two years, how frequently have you……?

1. Driven a car while under the influence of alcohol or drugs (or been driven by someone who is)

Not at all 1 2 3 4 5 6 7 Very frequently

2. Had sex with someone who is not a long term partner without a condom

Not at all 1 2 3 4 5 6 7 Very frequently

3. Smoked tobacco or cigarettes

Not at all 1 2 3 4 5 6 7 Very frequently

4. Been on a 'drinking binge' i.e. more than 8 units of alcohol in one session (One unit = 1/2 pint of lager or cider, 1 shots of spirit or 1 small glasses of wine)

Not at all 1 2 3 4 5 6 7 Very frequently

5. Had sex without any form of birth control therefore risking an unwanted pregnancy

Not at all 1 2 3 4 5 6 7 Very frequently

6. Smoked marijuana

Not at all 1 2 3 4 5 6 7 Very frequently

7. Mixed alcohol with another drug (prescription or illegal)

Not at all 1 2 3 4 5 6 7 Very frequently

8. Failed to use seat belt when in a moving vehicle (as a driver or passenger)

Not at all 1 2 3 4 5 6 7 Very frequently

9. Had casual sex/ a one night stand

Not at all 1 2 3 4 5 6 7 Very frequently

10. Broken the speed limit by more than 10 mph

Not at all 1 2 3 4 5 6 7 Very frequently

11. Taken illegal drugs other than marijuana

Not at all 1 2 3 4 5 6 7 Very frequently

12. Drank over 3-4 units of alcohol per day for all or most days of the week?

Not at all 1 2 3 4 5 6 7 Very frequently

Appendix 2H The Risk Propensity Scale
(Lion & Merteens, 2004)

Scale has been removed due to Copyright restrictions

Appendix 2I A Screenshot of the BART

Image has been removed due to Copyright restrictions

Appendix 2J Instructions for the Questionnaire Task

Task One Instructions

The Questionnaire Task

I would like you to complete six short questionnaires. Five of them will be presented on the computer and one will be presented on paper.

Please complete the paper questionnaire by hand before moving on to the computerised questionnaires.

Before the computerised questionnaires begin you will be asked to provide your age and gender.

The questionnaires may be in different formats so please read the instructions provided with each one carefully.

Some of the questionnaires measure similar things and it may feel like you are repeating yourself. Please do not worry about being 'consistent' and answer as honestly as you can.

As previously mentioned, you may be asked about sensitive issues like illegal or sexual activities. **It is important that your answers are completely truthful so if you feel you are not comfortable answering such questions truthfully; please do not take part in this experiment.** Again all of your data will be anonymous.

Do you have any questions at this point?

When you are ready, please begin the experiment by filling out the paper questionnaire in front of you then move on to the computerised task.

When you have finished please alert the experimenter who will set up the next task (Warning Task) for you if it is not already on screen.

.

Appendix 2K Instructions for the Warning Task

Task Two Instructions

Warning Task

During this task you will be presented with warnings, both visual signs and auditory alarms. I would like you to judge the hazard level of warning signs and alarms, that is, how much hazard or danger they represent. The warning symbols and alarms will be presented in two separate stages. In the auditory stage, please click the button labelled ‘Play alarm’ to hear the alarm as many times as necessary.

The warnings are intended to have different hazard levels and will be presented in a random order. Please give the warnings a number between 1 and 100 depending on the level of hazard you think they are intended to convey.

*In other words how much danger does each one communicate to **you** on a scale of 1 to 100?*

Please use low numbers to indicate less hazard and high numbers to indicate more hazard. There is no right or wrong answer; I want to know how **you** judge the hazard level of the warnings.

You will also be asked how likely you would be to comply with any instructions associated with the warning. Please select your answer from a scale between 1 (definitely would comply) to 7 (definitely would not comply). Think about how likely **you** would be to follow those instructions based on **your perceptions** of the warning itself.

Please follow all instructions given to you on screen. You will be given a few practice trials before the real task begins.

Do you have any questions at this point?

When you have finished please alert the experimenter who will set up the next task for you.

Please begin when you are ready.

Appendix 2L Instructions for the BART

Task Three Instructions

In this task you will be presented with 30 balloons (one at a time) on the computer screen and you must inflate each one by clicking your mouse. You will be awarded points for how much you inflate the balloons so make each one as big as possible before it bursts.

This is the task in which you will have the opportunity to win money by scoring highly so please try to score as many points as possible.

The **fifteen highest scorers** will win cash prises. The prizes are as follows:

- **1st to 3rd place = £10**
- **4th to 15th place = £5**

If you are amongst the highest scorers, I will need to contact you to give you your prize money. Therefore could you please provide me with a contact email address and/ or phone number? If you would prefer to be notified that you have won by phone please provide a contact number (please note that you will be notified by email if you haven't won).

Email…………………………..\ Tel……………………………

This means however, that I will see how many points you scored. **Your scores for this task only will not be fully confidential. This will not affect the confidentiality of your responses on the previous tasks. If you wish to keep this score confidential do not provide contact details,** however you may not receive any prize money as there is no way of identifying you as a winner.

Please put on the headphones provided and begin when you are ready. You will be presented with an example of what the balloon will look like on screen. Press 'click to continue' and you will be given further instructions.

Appendix 2M Descriptive statistics for all variables

The Mean Score, Standard Deviation and Cronbach's Alpha Coefficient for All Variables

	Mean	SD	α
Dependant variables			
Auditory Hazard Perception	48.28	15.37	. 97
Auditory Compliance	4.47	0.91	.96
Visual Hazard Perception	54.33	15.87	. 97
Visual Compliance	4.88	0.84	.95
Predictors			
Sensation Seeking	21.72	6.28	.80
Thrill and Adventure Seeking	6.38	2.52	.72
Experience seeking	6.36	1.97	.53
Dis-inhibition	5.60	2.30	.65
Boredom Susceptibility	3.38	2.17	.61
Impulsiveness	7.85	4.14	-
Venturesomeness	9.30	3.65	-
Behavioural Inhibition	21.40	3.66	.80
Behavioural Activation Drive	11.09	2.33	.76
Behavioural Activation Drive Fun Seeking	12.09	2.35	.73
Behavioural Activation Drive Reward	16.88	2.15	.63
Risk-taking propensity Scale	34.37	9.27	-
Risk Behaviour	27.96	10.68	.74
Risk Perception	57.56	10.89	.85
BART	43.82	14.26	-

Note the Cronbach's alpha was not carried out for impulsivity or venturesomeness. This was due to the nature of the scoring of the IVE as prescribed by the copyright licensing. The BART was not a psychometric scale and therefore scale analysis did not apply.

Appendix 2N The inter-correlations between the potential predictor variables of warning perception

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Impulsiveness (1)	-													
Venturesomeness (2)	.17*	-												
Risk Perception (3)	.07	-.16	-											
Behavioural Inhibition (4)	-.04	-.34**	.24**	-										
Bas Drive (5)	.26**	.20*	.02	-.08	-									
Bas Fun Seeking (6)	.46**	.48**	.09	-.06	.34**	-								
Bas Reward (7)	.13	-.01	.13	.37**	.20*	.31**	-							
Sensation Seeking (8)	.13	.71**	-.49**	-.35**	.21*	.37**	-.04	-						
Thrill and Adventure Seeking (9)	.09	.78**	-.28**	-.20*	-.02	.35**	.03	.70**	-					
Experience Seeking (10)	-.03	.43**	-.33**	-.28**	.01	.18*	.03	.70**	.44**	-				
Dis-inhibition (11)	.17*	.38**	-.43**	-.24**	.24**	.21**	-.04	.75**	.27**	.38**	-			
Boredom Susceptibility (12)	.12	.35**	-.32**	-.27**	.35**	.27**	-.15	.65**	.20*	.19*	.45**	-		
Risk-taking propensity (13)	.31**	.64**	-.30**	-.34**	.18*	.42**	.00	.65**	.47**	.52**	.44**	.40**	-	
Risk behaviour (14)	.23**	.29**	-.41**	-.09	.12	.23**	.09	.54**	.29**	.34**	.57**	.33**	.44**	-
Balloon Analogue Risk Task	-.11	.06	-.22**	-.16*	.07	.00	-.15	.19*	.05	.20*	.19*	.12	.11	.01

Note: * p<.05 and ** p<.01

Chapter 3 Appendices

Appendix 3A The rank ordered mean risk ratings for both recreational and health/safety behaviours combined

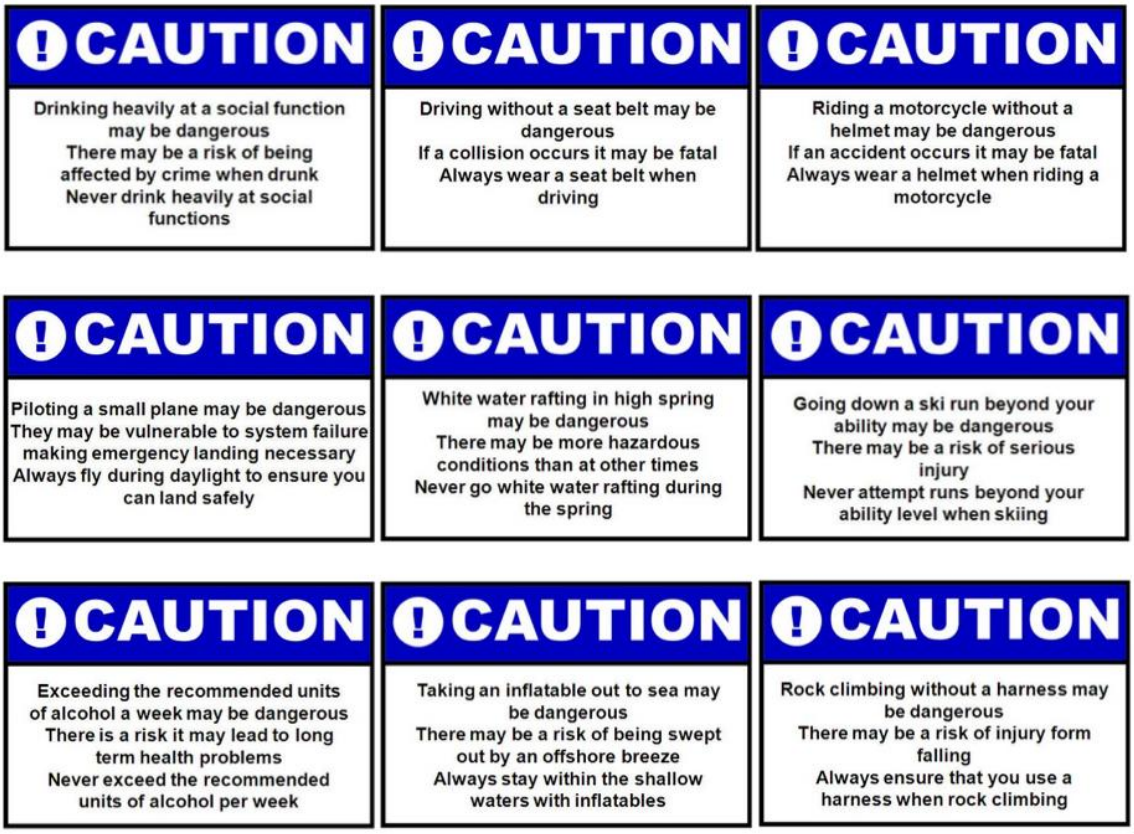
Behaviour	Risk rating (m)
Running a red light at a train crossing	9.18
Driving under the influence of alcohol	8.9
Riding a motorcycle without a helmet	8.33
Inserting a metal object into a toaster whilst in use	7.88
'Tomb-stoning' or cliff diving	7.53
Going down a ski run that is beyond your ability	7.45
Rock climbing without a harness	7.4
Driving at 50 mph in a residential area	7.33
Back-packing in a politically unstable country	7.3
Using heavy solvents in an unventilated area	7.28
Mountain climbing in unknown weather conditions	7.25
Smoking 20 cigarettes a day	7.2
Walking home alone at night in an unsafe area of town	6.93
Engaging in unprotected sex	6.85
Driving a car without wearing a seat belt	6.75
Crossing a dual carriageway without using a pedestrian crossing	6.75
Using an electrical appliance near water	6.6
Taking an inflatable out to sea	6.6
Going white-water rafting at high water in the spring	6.58
Exceeding the recommended dose of painkillers in 24 hours	6.3
Eating fish one week out of date	6.28
Hitch-hiking alone	6.23
Sunbathing without sunscreen	6.15
Attempting stunts or tricks while skateboarding without protective gear	6.13
Deep scuba diving (over 30 meters)	6.08
Listening to music above 90db for a prolonged period of time	5.68
Paragliding on a rainy day	5.63
Bungee jumping off a tall bridge	5.33
Piloting a small plane	4.93
Riding a horse bareback (without a saddle)	4.8
Drinking heavily at a social function	4.7
Swimming at a beach not manned by life guards	4.63
Water-skiing at a holiday resort	4.53
Engaging in a high contact martial art	4.51
Drinking more than the recommended units of alcohol a week	4.35
Using bleach based cleaning products without wearing protective gloves	4.25
Taking a skydiving class	3.8
Going camping in the wilderness	3.53

Appendix 3B the DOSPERT scales

Scale has been removed due to Copyright restrictions

Appendix 3C Study Two warning stimuli

Appendix 3C continued



Appendix 3D A Comparison of Data from Lab and Internet Studies

The two data sets obtained from the laboratory study and the online study were compared to ensure the means for each variable did not significantly differ thus allowing them to be combined into a homogenous data set.

The means for hazard perception and intended compliance between the lab and internet study were compared in order to establish any differences between the two data sets. MANOVAs revealed no significant differences between the two data collection methods. The F statistics and p values from these analyses are presented in Table A1 along with the mean scores and standard deviations for both methods. The analysis revealed that there were no significant differences in hazard perception and intended compliance between the methods of recruitments, therefore the laboratory based and internet based participants did not perceive the warnings differently.

Table A1*The Mean and Standard Deviation for Hazard Perception and Intended Compliance Ratings*

	Lab		Internet			
Hazard Perception	Mean	SD	Mean	SD	$F_{(1,284)}$	p=
Over all	63.93	13.44	65.26	16.83	.25	.620
High hazard warnings	69.97	13.68	72.30	16.72	.76	.385
Low hazard warnings	57.88	15.64	58.22	20.28	.01	.915
Health & Safety warnings	64.74	13.05	65.75	17.15	.14	.710
Recreational warnings	64.32	13.96	65.89	17.52	.32	.574
Intended Compliance						
Over all	5.22	.82	5.39	.90	1.39	.240
High hazard warnings	5.46	.81	5.62	.86	1.31	.253
Low hazard warnings	4.98	.93	5.16	1.07	1.14	.286
Health & Safety warnings	5.21	.73	5.35	.92	1.01	.316
Recreational warnings	5.30	.94	5.50	1.01	1.52	.219

The mean scores for each domain and scale of the DOSPERT were also compared across the two recruitment methods. The means and F statistics for each analysis are displayed in Table A2. The analysis revealed that there were no significant differences in DOSPERT scores for all domains of the risk perception and expected benefits scales. There were however, significant differences between scores on the social, recreational and financial domains of the behavioural likelihood scale. Examination of the partial ETA squared revealed small effect sizes (all $\eta p^2 < .02$), meaning there were small differences between the two methods of recruitment.

Table A2
Descriptive statistics for scores on the DOSPERT

		Lab		Internet			
Subscale	Domain	Mean	SD	Mean	SD	$F_{(1,284)}$	p=
Risk Behaviour	Social	34.59	5.03	32.82	5.35	4.13	.043
	Recreational	25.82	8.78	22.47	9.52	4.69	.031
	Financial	17.82	6.39	15.13	6.48	6.43	.012
	Health & Safety	21.36	5.77	20.04	7.05	1.38	.241
	Ethical	15.80	5.29	14.62	5.43	1.74	.188
Risk Perception	Social	14.52	4.65	15.64	6.11	1.34	.249
	Recreational	23.98	7.53	25.87	7.32	2.45	.118
	Financial	30.25	6.21	30.96	6.55	.45	.505
	Health & Safety	28.61	5.72	30.07	6.15	2.13	.146
	Ethical	27.68	5.99	29.03	6.43	1.66	.198
Expected Benefits	Social	26.05	5.27	25.19	5.85	.82	.365
	Recreational	21.25	7.47	19.14	8.65	2.30	.131
	Financial	17.43	7.62	15.95	6.64	1.75	.187
	Health & Safety	10.25	3.91	9.83	4.21	.38	.536
	Ethical	13.91	4.28	13.27	5.45	.54	.463

As the majority of the means did not significantly differ between the two recruitment methods, the two data sets were combined for further analysis N=280, age = 18-74, M (SD) =28.86 (11.76), Male = 103, Female =177.

Appendix 3E Reliability and manipulation checks

Reliability of DOSPERT Scales

Reliability analyses were carried out on the combined DOSPERT data. The mean score, standard deviation and Cronbach's alpha coefficient for hazard perception and intended compliance to the warning stimuli are also displayed in Table A3. The alpha scores revealed that for the risk behaviour scale, the social, health & safety and ethical domains were moderately reliable, whereas the recreational and financial domain were highly reliable. For the risk perception scale, all domains were highly reliable. For the expected benefits scale, the social, health & safety and ethical domains were moderately reliable, whereas the recreational and financial domains were highly reliable (Kline, 1999).

Table A3

Mean, Standard Deviation and Cronbach's Alpha Coefficients for the Scales and Domains of the DOSPERT

Subscale	Domain	Mean	SD	α
Risk Behaviour	Social	33.10	5.33	.66
	Recreational	23.00	9.47	.84
	Financial	15.55	6.52	.77
	Health & Safety	20.25	6.87	.64
	Ethical	14.81	5.41	.57
Risk Perception	Social	15.47	5.91	.77
	Recreational	25.57	7.37	.83
	Financial	30.85	6.49	.83
	Health & Safety	29.84	6.10	.73
	Ethical	28.82	6.37	.73
Expected Benefits	Social	25.32	5.77	.66
	Recreational	19.47	8.50	.87
	Financial	16.19	6.81	.85
	Health & Safety	9.89	4.16	.66
	Ethical	13.37	5.28	.65

Reliability of Warning Stimuli

To ensure the stimuli were reliable, reliability analyses were carried out on the warning perception variables. The alpha score was >.90 which indicates very high reliability (Kline, 1999). The mean score, standard deviation and Cronbach's alpha coefficient for hazard perception and intended compliance to the warning stimuli are displayed in Table A4.

In order to check that participants' hazard perceptions were related to their intentions to comply the two were correlated. Pearson's correlation revealed a highly significant relationship between hazard perception and intended compliance scores for all warning stimuli $r\ (284) = .61$, $p < .001$. Consistent with previous research, as hazard perception increased so did intentions to comply.

Table A4

The Mean and Standard Deviation for Hazard Perception and Intended Compliance Ratings

Hazard Perception	Mean	SD	α
Over all	65.05	16.33	.95
High hazard warnings	71.93	16.28	.92
Low hazard warnings	58.17	19.60	.95
Health & Safety warnings	65.59	16.56	.91
Recreational warnings	65.65	17.00	.92
Intended Compliance			
Over all	5.36	.89	.92
High hazard warnings	5.59	.85	.84
Low hazard warnings	5.13	1.05	.89
Health & Safety warnings	5.33	.89	.85
Recreational warnings	5.47	1.00	.90

Did the Participants Perceive the Item-Relevant and Irrelevant Warnings as Intended?

The behaviours were selected to be approximately matched between item-relevant and item-irrelevant warnings and between domains. To ensure that participants perceived the stimuli as intended, a MANOVA was conducted with hazard perception and intended compliance to each warning domain as dependant variables and domain and item-relevance as independent variables. The means and standard deviations from the analysis are displayed in Table A5.

Table A5
Mean Hazard Perception and Intended Compliance for Item-relevant and Irrelevant Warnings

	Item Relevance	Mean	SD
Hazard Perception			
Health & Safety	Relevant	66.08	14.20
	Irrelevant	65.10	12.20
Recreation	Relevant	64.22	7.57
	Irrelevant	64.80	10.40
Intended Compliance			
Health & Safety	Relevant	5.44	1.17
	Irrelevant	5.22	0.95
Recreation	Relevant	5.29	0.28
	Irrelevant	5.49	0.42

The analysis revealed no significant difference between ratings of hazard perception F (1, 24) =.055, p = .817 and intended compliance F (1, 24) =.035, p = .853 for warnings of different domains. That is, there were no significant differences in the perceived hazard or intentions to comply with the warnings from the health & safety domain and the recreational domain. The analysis also confirmed that the item-relevant warnings were approximately equal in terms of hazard perception and intentions to comply with item-irrelevant warning. There was no significant effect of item-relevance for hazard perception F (1, 24) =.002, p = .966 or intended compliance F (1, 24) =.001, p = .970.

These results suggest that the intentions of the pilot study (to identify behaviours which were approximately matched in terms of their hazard level across item-relevance and domain) were successful.

Appendix 3F Correlations between Subscales and Domains of the DOSPERT

In order to check that the subscales of the DOSPERT were related, and that the correlations were stronger within each domain, a Pearson's correlation was carried out on the subscales and domains of the DOSPERT. The correlation coefficients and associated significance levels are displayed in TableA6. The coefficients highlighted in bold show that across participants and subscale items, the risk behaviour scale was negatively correlated with the risk perception scale and positively correlated with the expected benefits scale for every domain of the DOSPERT. The risk perception scale was also negatively correlated with the expected benefits scale for every domain. It can also be noted that these within-domain correlations were higher than the correlations across domains, thus demonstrating the domain specificity of risk-taking behaviour, risk perception and expected benefits associated with risky behaviours.

Table A6
Correlations between the Subscales and Domains of the DOSPERT

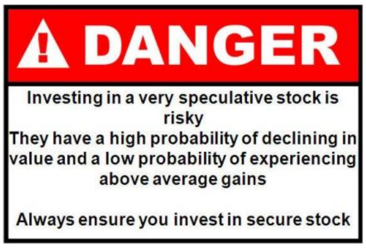
	Likelihood					*Risk Perception*					*Benefits*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Likelihood															
Social(1)	-														
Recreational(2)	.367**	-													
Financial(3)	.097	.247**	-												
Health & Safety(4)	.268**	.473**	.249**	-											
Ethical(5)	.124*	.216**	.310**	.411**	-										
Risk Perception															
Social(6)	**-.384****	-.163**	-.142*	-.210**	.015	-									
Recreational(7)	-.242**	**-.583****	-.225**	-.394**	-.206**	.393**	-								
Financial(8)	.010	-.167**	**-.470****	-.167**	-.112	.269**	.427**	-							
Health & Safety(9)	-.095	-.239**	-.335**	**-.579****	-.361**	.308**	.569**	.452**	-						
Ethical(10)	-.042	-.100	-.143*	-.276**	**-.492****	.199**	.408**	.378**	.664**						
Benefits															
Social(11)	**.516****	.290**	.028	.120*	.060	**-.261****	-.159**	.016	.043	.114	-				
Recreational(12)	.286**	**.735****	.188**	.324**	.172**	-.052	**-.469****	-.074	-.152*	-.019	.415**	-			
Financial(13)	-.010	.138*	**.522****	.151*	.237**	-.012	-.119*	**-.266****	-.191**	-.119*	.075	.197**	-		
Health &Safety(14)	-.052	.188**	.189**	**.401****	.323**	.020	-.222**	-.171**	**-.442****	-.292**	.104	.298**	.225**	-	
Ethical(15)	-.018	.101	.196**	.239**	**.572****	.104	-.124*	-.088	-.314**	**-.416****	.045	.197**	.442**	.490**	-

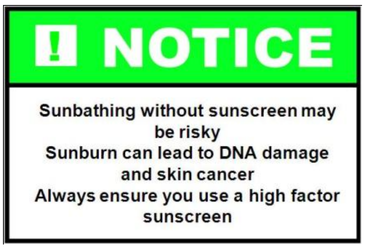
Note: * p<.05 and ** p<.01

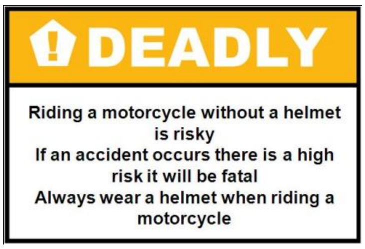
Appendix 3G The rank ordered mean ratings for both financial and health & safety behaviours combined

Behaviour	Risk rating
Betting a month's income on a roulette wheel	9.19
Running a red light at a train crossing	8.94
Investing a month's income in a pyramid scheme	8.94
Driving under the influence of alcohol	8.75
Riding a motorcycle without a helmet	8.59
Entering your credit/debit card details on an unsecured internet site	8.59
Continuing to gamble in a casino to make up for losses you have already incurred	8.41
Buying a used car from an independent seller without viewing it	8.09
Smoking 20 cigarettes a day	7.88
Inserting a metal object into a toaster whilst in use	7.75
Regularly betting on an internet gambling site	7.53
Investing in property for development costing over 4 times your annual salary	7.41
Spending a day's income on the national lottery tickets	7.34
Driving a car without wearing a seat belt	7.31
Putting a day's income into a fruit machine	7.28
Betting a day's income at a high-stake poker game	7.25
Taking out a store credit card to buy items you can't afford now	7.25
Betting a day's income at the horse races	7.19
Eating fish one week out of date	7.09
Using heavy solvents in an unventilated area	7.00
Driving at 50 mph in a residential area	6.97
Using an electrical appliance near water	6.91
Betting a day's income on the outcome of a sporting event	6.91
Investing 10% of our annual income in shares of a new company	6.88
Crossing a dual carriageway without using a pedestrian crossing	6.72
Engaging in unprotected sex	6.56
Investing 5% of your annual income in a very speculative stock	6.53
Walking home alone at night in an unsafe area of town	6.50
Listening to music above 90db for a prolonged period of time	6.47
Sunbathing without sunscreen	6.44
Exceeding the recommended dose of painkillers in 24 hours	6.41
Taking out a large loan for a luxury item	6.31
Investing 10% of your annual income in a new business venture	6.19
Investing 10% of your annual income in a collective investment fund	5.69
Investing 10% of your annual income in an offshore bank account	5.59
Drinking heavily at a social function	5.47
Drinking more than the recommended units of alcohol a week	5.00
Using bleach based cleaning products without wearing protective gloves	4.28

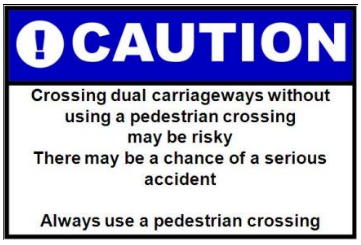
Appendix 3H Study Three warning stimuli

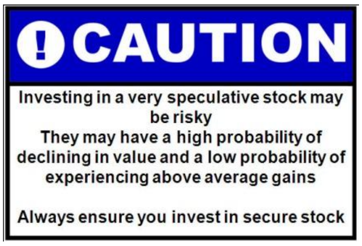


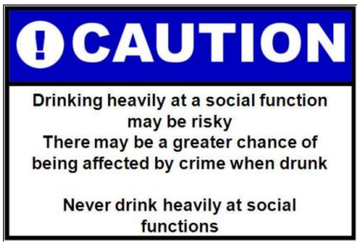




Appendix 3H Continued







Appendix 3I Reliability and manipulation checks

Reliability of DOSPERT scales

Reliability analyses were carried out on the combined DOSPERT data. The mean score, standard deviation and Cronbach's alpha coefficient for hazard perception and intended compliance to the warning stimuli are displayed in table A7. The alpha scores revealed that for all scales, reliability of the domains ranged from moderate (>.52) to high (<.82).

Table A7

Mean Standard Deviation and Cronbach's Alpha Coefficient for the Scales and Domains of the DOSPERT

Subscale	Domain	Mean	SD	α
Risk Behaviour	Social	31.79	4.46	.53
	Recreational	23.84	9.05	.85
	Financial	14.81	5.40	.72
	Health & Safety	20.59	5.84	.55
	Ethical	14.47	4.72	.59
Risk Perception	Social	16.05	4.96	.68
	Recreational	25.99	6.36	.75
	Financial	31.26	6.08	.80
	Health & Safety	31.48	5.20	.71
	Ethical	30.03	4.63	.49
Expected Benefits	Social	25.16	5.33	.65
	Recreational	21.02	8.18	.87
	Financial	17.11	7.04	.86
	Health & Safety	9.69	3.42	.52
	Ethical	13.99	5.17	.66

Reliability of warning stimuli

To ensure the stimuli were reliable, reliability analyses were carried out on the warning perception variables. The alpha score was >.79 for each dependant variable which indicates high reliability (Kline, 1999). The mean score, standard deviation and Cronbach's alpha coefficients for hazard perception and intended compliance to the warning stimuli are displayed in Table A8.

Table A8

The Mean and Standard Deviation for Hazard Perception and Intended Compliance Ratings

Hazard Perception	Mean	SD	α
Over all	55.28	13.19	.94
High hazard warnings	61.46	14.75	.91
Low hazard warnings	49.10	14.74	.92
Health & Safety warnings	61.00	12.54	.88
Financial warnings	49.57	16.02	.88
Intended Compliance			
Over all	5.01	.69	.88
High hazard warnings	5.27	.72	.80
Low hazard warnings	4.75	.80	.83
Health & Safety warnings	5.19	.70	.80
Financial warnings	4.82	.91	.79

In order to check that participants' hazard perceptions were related to their intentions to comply scored on the two predictor variables were correlated. Pearson's correlation revealed a highly significant relationship between hazard perception and intended compliance scores for all warning stimuli $r(198) = .56$, $p < .001$. Consistent with previous research, as hazard perception increased so did intentions to comply.

The behaviours were selected to be approximately matched in risk level between item-relevant and item-irrelevant and across domains. To ensure the participants perceived the warning stimuli as intended, a MANOVA was conducted with hazard perception and intended compliance as dependant variables and domain and item-relevance as independent variables. The mean and standard deviations from the analysis are displayed in Table A9

Table A10
Mean Hazard Perception and Intended Compliance for Item-relevant and Irrelevant Warnings

	Item Relevance	Mean	Std. Deviation
Hazard Perception			
Health & Safety	Relevant	60.50	10.30
	Irrelevant	61.49	13.15
Financial	Relevant	50.91	6.33
	Irrelevant	48.22	6.53
Intended Compliance			
Health & Safety	Relevant	4.92	.33
	Irrelevant	4.72	.33
Financial	Relevant	5.16	1.03
	Irrelevant	5.22	1.24

The analysis revealed a significant main effect of domain on hazard perception. There was a significant difference between ratings of hazard perception F (1, 23) =.8.67, p <.01 ηp^2 =.30. Participants judged the health & safety warnings to imply higher levels of hazard than the financial warnings. The analysis revealed no significant difference across domains for intended compliance F (1, 23) =1.17, p=.291. Participants' intentions to comply with health & safety warnings were not significantly higher than for financial warnings.

There was no main effect of item-relevance on hazard perception, the analysis confirmed that there was no significant difference between hazard perception scores F (1, 23) =.048, p = .829 for item-relevant warnings and irrelevant warnings. Participants perceived no difference in hazard level between warnings created from items selected from the DOSPERT and behaviours which were not featured in the scale. There was no main effect of item-relevance on intended compliance, there was no significant difference between intentions to comply (F (1, 23) =.048, p = .829) with item-relevant warnings and irrelevant warnings. Participants' intentions to comply with warnings were not significantly different for warnings created from items selected from the DOSPERT or behaviours which were not featured in the scale.

These results suggest that the intentions of the pilot study (to identify behaviours which were approximately matched in terms of their hazard level across item-relevance and domain) were partially successful. The item-relevant warnings were judged the same as the item-irrelevant however, participants perceived more hazard from the health & safety warnings than from the financial ones.

Appendix 3J Correlations between Subscales and Domains of the DOSPERT

In order to check that the subscales of the DOSPERT were related, and that the correlations were stronger within each domain, a Pearson's Correlation was carried out on the subscales and domains of the DOSPERT. The correlation coefficients and associated significance levels are displayed in Table A11. The coefficients highlighted in bold show that across participants and subscale items, the risk behaviour scale was negatively correlated with the risk perception scale and positively correlated with the expected benefits scale for every domain of the DOSPERT. The risk perception scale was also negatively correlated with the expected benefits scale for every domain except social risks. It can also be noted that these within-domain correlations were higher than the correlations across domain, with two exceptions. The ethical domain of expected benefits was more strongly correlated with health & safety risk behaviour and risk perception than was the health & safety expected benefits.

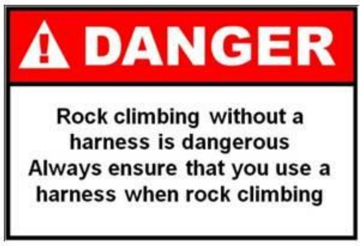
Table A11

	Likelihood					*Risk Perception*					*Benefits*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Likelihood															
Social(1)	-														
Recreational(2)	.219**	-													
Financial(3)	.191**	.270**	-												
Health & Safety(4)	.155*	.195**	.180*	-											
Ethical(5)	.034	.155*	.261**	.505**	-										
Risk Perception															
Social(6)	**-.375****	-.110	-.028	-.192**	.012	-									
Recreational(7)	-.077	**-.469****	-.101	-.197**	-.126	.348**	-								
Financial(8)	-.090	-.189**	**-.560****	-.117	-.248**	.175*	.341**	-							
Health & Safety(9)	-.049	-.156*	-.076	**-.443****	-.313**	.230**	.360**	.237**	-						
Ethical(10)	-.049	-.107	-.125	-.308**	**-.476****	.306**	.333**	.350**	.577**						
Benefits															
Social(11)	**.396****	.006	.093	.020	-.045	**.005**	.049	.051	.099	.165*	.165*	-			
Recreational(12)	.127	**.557****	.232**	.109	.110	.000	**-.313****	-.166*	-.049	-.001	-.001	.353**	-		
Financial(13)	.094	.200**	**.375****	.208**	.127	-.018	-.046	**-.230****	-.058	-.047	-.047	.246**	.389**	-	
Health &Safety(14)	.006	.124	.090	**.227****	.263**	.104	-.020	-.102	**-.179***	-.008	-.008	.193**	.352**	.256**	-
Ethical(15)	-.032	.067	.092	.368**	**.440****	.033	-.037	.008	-.208**	**-.251****	-.251**	.118	.194**	.452**	.433**

Chapter 4 Appendices

Appendix 4A Warning stimuli

Experimental Warnings

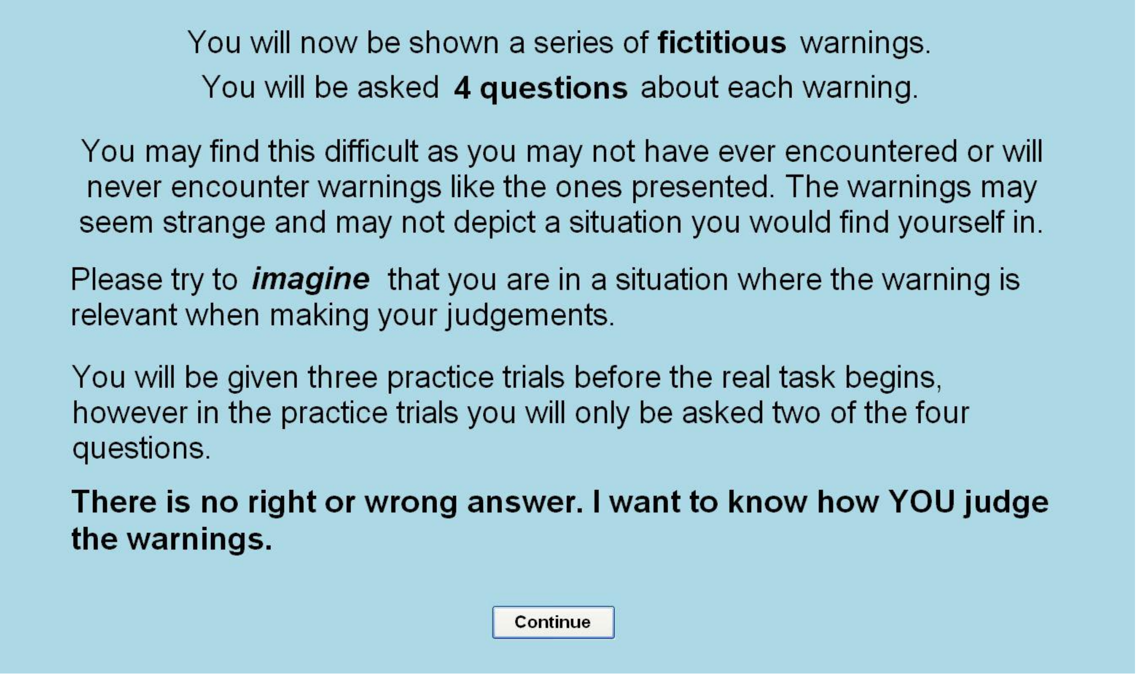


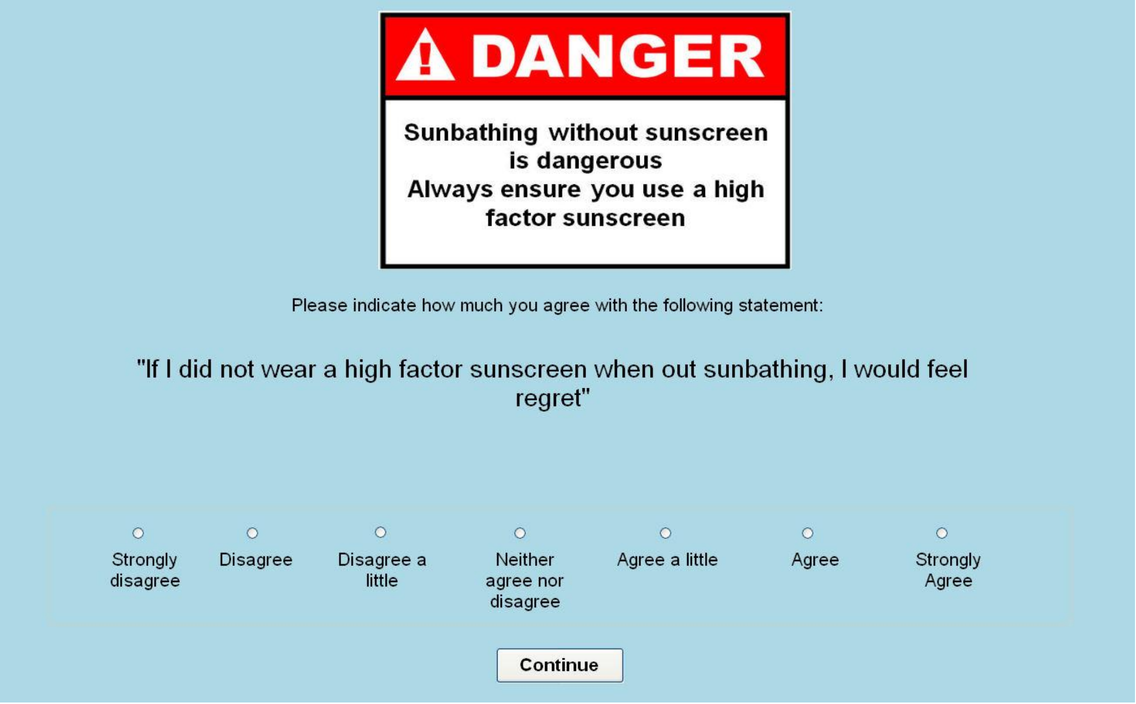
Practice Warnings

Appendix 4B Anticipated regret statements

1. If I did not wear a helmet when riding a motorcycle, I would feel regret
2. If I drove a vehicle while I was drunk, if would feel regret
3. If I inserted a metal object into a toaster while it was plugged into the mains, I would feel regret
4. If I went down a ski run that was beyond my ability, I would feel regret
5. If I did not check the weather conditions before I set off on a mountain climb, I would feel regret
6. If I did not wear a harness while rock climbing, I would feel regret
7. If I did not wear a high factor sunscreen when out sunbathing, I would feel regret
8. If I did not use a pedestrian crossing when crossing a dual carriage way, I would feel regret
9. If I drank more than the recommended units of alcohol a week, I would feel regret
10. If I took an inflatable out to sea, I would feel regret
11. If I did not ensure that there was a lifeguard present when I swam in the sea, I would feel regret
12. If I did not check the weather conditions before going paragliding, I would feel regret

Appendix 4C Screen shots from the warning task
displaying the instructions, anticipated regret and prefactual measure





Again, please imagine you are in a situation where this warning is relevant

Please list the thoughts that would go through your mind when deciding to comply with this warning

Please keep your thoughts relevant to the situation and try not to take longer 2 minutes

Continue

Appendix 4D Pre factual coding scheme

1. **Identify prefactual statements**

Definitions in literature:

'Simulations before the fact, what might be', 'imagination before the fact, of alternative predicted possible outcomes', 'Alternative predictions…before any outcomes are known' (Sanna, 1996., p, 1020)

A Statement that 'explicitly acknowledge(s) an alternative reality of how things might be, for example "maybe if I look around later, I'll find it cheaper somewhere else and I can get the difference back later"'(McConnell et al. 2000, p289).

'What would have to happen a particular future outcome to differ from the present situation ("if I chair the next meeting, results will be better").' (Goerk et al. 2004, p281).

Working Definition:

Sentences that give evidence that the individual is speculating specific future outcomes of following/not following the warning.

Evidence that the individual is simulating specific outcomes as a result of their own behaviour.

Such sentences are likely to included words like: *If, what if, would, could, will, might.* (but not all see examples below).

The prefactuals must be specific (e.g. 'it is dangerous' or 'it will be dangerous' are too general and featured in the warning it's self).

2. **Rate the direction of the statement**

Upward or downward (Positive or negative)

Examples

Upward (these can be the benefits of not following the warning or the stimulation

that the negative consequences won't happen)

- ✓ It could be/ it will be more fun
- ✓ It will be a new challenge
- ✓ I want to get a tan
- ✓ I want to have a fun night out

- ✗ I can't see the harm (not specific)
- ✗ It isn't going to hurt
- ✗ It is fun (present tense)

- ✗ Drinking over the limit will not have a profound immediate effect
- ✗ It could pay off if I could manage it (ski run; not specific)
- ✗ I will be fine

Downward (again make sure they are specific)

- ✓ (it) would lead to either death or serious injury
- ✓ It will stop me getting a serious head injury
- ✓ I might not drink much to avoid feeling rubbish.
- ✓ I couldn't cope if I was the cause of an accident

- ✗ It could be very dangerous
- ✗ I would feel nervous
- ✗ If the weather is bad it puts you in even more danger
- ✗ Drinking too much can be dangerous if done daily
- ✗ I consider rock climbing dangerous and without a harness this would be the case even more.
- ✗ Something bad might happen
- ✗ Whether I could seriously hurt myself.
- ✗ I could get hurt / someone could get hurt
- ✗ It might cause me harm not to comply

Words like bad, harm, hurt, injury, danger, dangerous, accident etc. are not specific enough unless they include a specific context.

Not all uses of the above words counts as a prefactual

- ✗ I wouldn't really see this as a threat
- ✗ I think I know when I would be out of my depth
- ✗ If it were to say sunbathing without sunscreen may cause skin cancer then I would be much more likely to comply.
- ✗ This is an everyday occurrence so I would not comply
- ✗ I would check my surroundings
- ✗ It would depend on how close the crossing was

People often enquire about the consequences without actually stating whether they think they will be positive or negative. These are NOT prefactuals.

- ✗ Will there be serious consequences?
- ✗ What are the chances of something negative happening to me?
- ✗ What are the consequences?
- ✗ I would think about the consequences

- ✗ How much risk is there if I do fall down?
- ✗ How likely is it that I will get electrocuted?
- ✗ What are the risks?

Sometime people just list the consequences (if they are specific then these are prefactuals)

- ✓ Skin cancer
- ✓ Getting caught,
- ✓ Having licence taken away.
- ✓ I do not want my face smashed in
- ✓ Pain
- ✓ Adrenaline rush

- ✗ Health problems

Some people make statements about the actual thoughts they have/might have (about consequences) again if specific then they count as prefactuals.

- ✓ Thoughts of people getting knocked over and killed
- ✓ The thought of being dragged away

- ✗ I wouldn't really think about risks/ consequences

Speculations about emotions that they would feel as a direct result of not following the warning are included but must be specific

- ✓ I would feel very pankiy and anxious if I didn't wear sunscreen
- ✓ I would be scared to hurt myself
- ✓ I would be petrified of falling
- ✓ The thought of electrocuting myself scares me

- ✗ I would feel nervous
- ✗ I would be worried
- ✗ I would be wary

Queries about the situation which affect the outcome are NOT counted as prefactuals.

- ✗ How busy is the dual carriageway?
- ✗ How confident am I feeling at the time?

- Who am I with?
- Do I have suitable equipment?
- Am I in a rush?
- Do I really need a helmet? How long is the journey?

Factors of experience, so things that have happened in the past are NOT prefactuals

- I would think about past experiences
- I've done it before and nothing happened
- Many people have tried doing it before and hurt themselves
- I would think about the number of accidents I have heard about

Statements about how dangerous (etc) something is in the present tenses are NOT prefactuals

- Many people die from it
- It is dangerous
- Getting burnt really hurts
- It is a common cause of death
- I know people who this has killed

Rhetorical questions do not count

- Why put others at risk as well as yourself?
- Why put yourself in danger?

Conditionals

There may be some pre-factual thinking going on here, it's two-tailed and they are ignoring the basic premise of the warning, which is never ever to do that action. These are not specific outcomes.

- 'If it looked safe I would cross'
- 'If there was an emergency I would think about it'.

Appendix 4E Consideration of Future Consequences Scale

Scale has been removed due to Copyright restrictions

Appendix 4F The brief for Study Four

Warnings and Thinking Styles

- **What is this study about?**

This study aims to investigate how a person's thinking style may affect the way they interact with warnings.

- **What will I have to do?**

You will be asked to complete 3 tasks:

1. A questionnaire (36 items) asking you about how you consider the future. This will be administered on paper.
2. A warning task where you will also be shown 15 fictitious warning labels and will be asked four questions about each one e.g. how likely you would be to follow it. This will be administered on the computer.
3. A personality questionnaire (40 items) which assesses how much of a sensation seeker you are. This will be administered on the computer.

- **How long will it take?**

About 45 -60 minutes.

- **What about confidentiality?**

Your responses will be anonymous and confidential.

- **What if I decide I don't want to do it?**

You have the right to stop the study at any point. You will be given a participant number so that if you want to withdraw your data at a later date, you can contact the researcher and your data will be destroyed.

Do you have any questions?

Chapter 5 Appendices

Appendix 5A The piloted behaviours
and three most frequently reported consequences

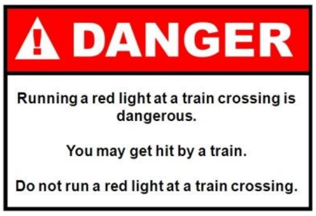
Behaviour		Risk level (m)	
Swimming at a beach not manned by life guards			*4.23*
Positive Consequences		Negative Consequences	
no freedom restriction	21	drowning/death	23
more private/less busy	16	no one to save you	15
enjoy swim	4	pulled out in current	10
Smoking marijuana			*4.27*
Positive Consequences		Negative Consequences	
relaxing	26	mental health problems	27
fun/enjoyment	17	cognitive problems/memory loss	11
social aspects	11	lack of motivation	10
Binge drinking on a night out			*5.15*
Positive Consequences		Negative Consequences	
enjoyment	16	stupid/irresponsible/reckless behaviour	15
socialising	11	hangover	9
Lack of inhibition/confidence	6	vomiting/sickness	8
Crossing a dual carriage way without using a pedestrian crossing			*5.23*
Positive Consequences		Negative Consequences	
saves time/distance	43	death of self	25
adrenaline	1	getting hit/run over	22
safer than subway	1	injury of self	21
Regularly betting on an internet gambling site			*5.35*
Positive Consequences		Negative Consequences	
win money	29	cost/loss of money	33
excitement/fun	18	addiction	22
entertainment/pass time	4	debt/bankruptcy	13
Having a large number of sexual partners			*5.38*
Positive Consequences		Negative Consequences	
fun	27	get STI	33
variety/experience	19	pregnancy	13
Positive reputation	5	Negative reputation	10
Betting a day's income at a high-stake poker game			*5.67*
Positive Consequences		Negative Consequences	
win money	38	loss of money	40
excitement/fun	13	debt/poverty/can't pay bills	11
good story	1	addiction	6
Regularly exceeding the recommended units of alcohol a week			*5.83*

Positive Consequences		Negative Consequences	
enjoyment	24	long term health issues/ illness	26
socialising	18	liver damage	21
Lack of inhibition/confidence	6	poor decision making /irresponsible behaviour	20
Back-packing in a politically unstable country			*6.17*
Positive Consequences		Negative Consequences	
excitement/thrill/ fun	13	kidnap/going missing/held hostage	19
more real experience/ off beaten track	11	attack/violence	12
see new places/ things not many people see	9	theft of property	11
Sunbathing without sunscreen			*6.23*
Positive Consequences		Negative Consequences	
better tan	33	skin cancer	31
easier/convenience	8	sunburn	29
less oily and messy	7	wrinkles/premature aging	12
Listening to music above 90db for a prolonged period of time			*6.29*
Positive Consequences		Negative Consequences	
enjoyment/sounds better	30	hearing loss	37
drown out other sounds	4	annoy others	6
escapism	4	pain/tinnitus	6
Walking home alone at night in an unsafe area of town			*6.33*
Positive Consequences		Negative Consequences	
home quicker/ short cut	18	attacked/injured	30
cost of taxi	7	mugged	28
convenience	5	raped/ sexual assault	18
Breaking the speed limit in a residential area by more than 10mph			*6.58*
Positive Consequences		Negative Consequences	
save time	36	injury/death others	37
feeling of speed/ enjoyment	4	legal penalty	18
overtaking people	1	less control	8
Driving without a seat belt			*6.90*
Positive Consequences		Negative Consequences	
comfort/less restriction	19	death to self	32
freedom	6	injury	28
speed	5	legal punishment	17
Going down a ski run that is beyond your ability			*7.15*
Positive Consequences		Negative Consequences	
excitement/thrill	27	injury	40
challenge	10	death	19
achievement	10	danger to others	10
Taking 'hard' drugs (class A)			*7.46*
Positive Consequences		Negative Consequences	
getting high/rush	23	addiction	22
enjoyment	8	death	20

socialising	7	health risk	16
Smoking over 20 cigarettes a day			*7.73*
Positive Consequences		Negative Consequences	
stress relief/relaxation	10	long term health problems	24
satisfaction/enjoyment	5	cancer	24
reduced appetite	5	cost	20
Driving a meter away from a car in front of you on a motorway			*7.77*
Positive Consequences		Negative Consequences	
getting the car to hurry up/move out of the way	12	crash/accident	28
aerodynamics/reduction of petrol usage	2	injury to self	13
feel superior	1	not enough time to react	12
Having unprotected sex with someone you just met			*7.96*
Positive Consequences		Negative Consequences	
enjoyment/fun/thrill	24	STI	42
sensitivity/feels better	11	pregnancy	27
could lead to good relationship	4	negative feelings e.g. Shame, embarrassment	11
'Tomb-stoning'			*7.96*
Positive Consequences		Negative Consequences	
excitement/fun/thrill	37	death/ drown	32
bravery/looking cool	8	injury	30
freedom	4	paralysis/disability	6
Rock climbing without a harness			*8.42*
Positive Consequences		Negative Consequences	
excitement	12	death	30
challenge	8	injury	21
freedom	8	fall	20
Driving when you feel drunk			*8.60*
Positive Consequences		Negative Consequences	
get home easily/ convenience	16	death/injury of others	33
save cost of taxi	11	injury	21
less risk than walking drunk/night bus	3	crash	21
Riding a motorcycle without a helmet			*8.69*
Positive Consequences		Negative Consequences	
freedom, sensation of wind in hair/face	15	death	30
better view/vision	7	injury	25
comfort	7	legal punishment	9
Running a red light at a train crossing			*8.71*
Positive Consequences		Negative Consequences	
speed	19	death	25
avoid wait	10	hit by train	24
thrill/enjoyment	4	death/injury to others	14

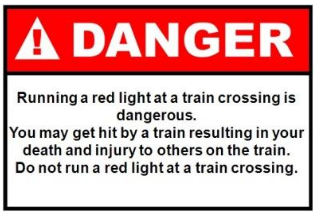
Appendix 5B Warning stimuli

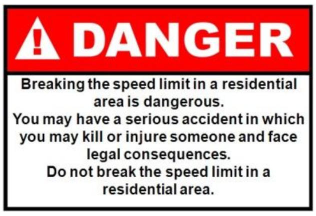
Control condition



Appendix 5B continued

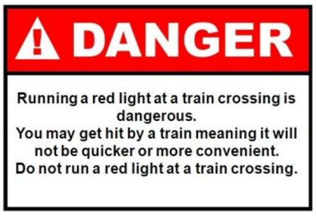
Negative Condition

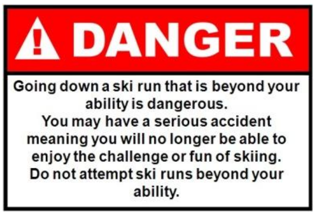




Appendix 5B continued

Positive Condition

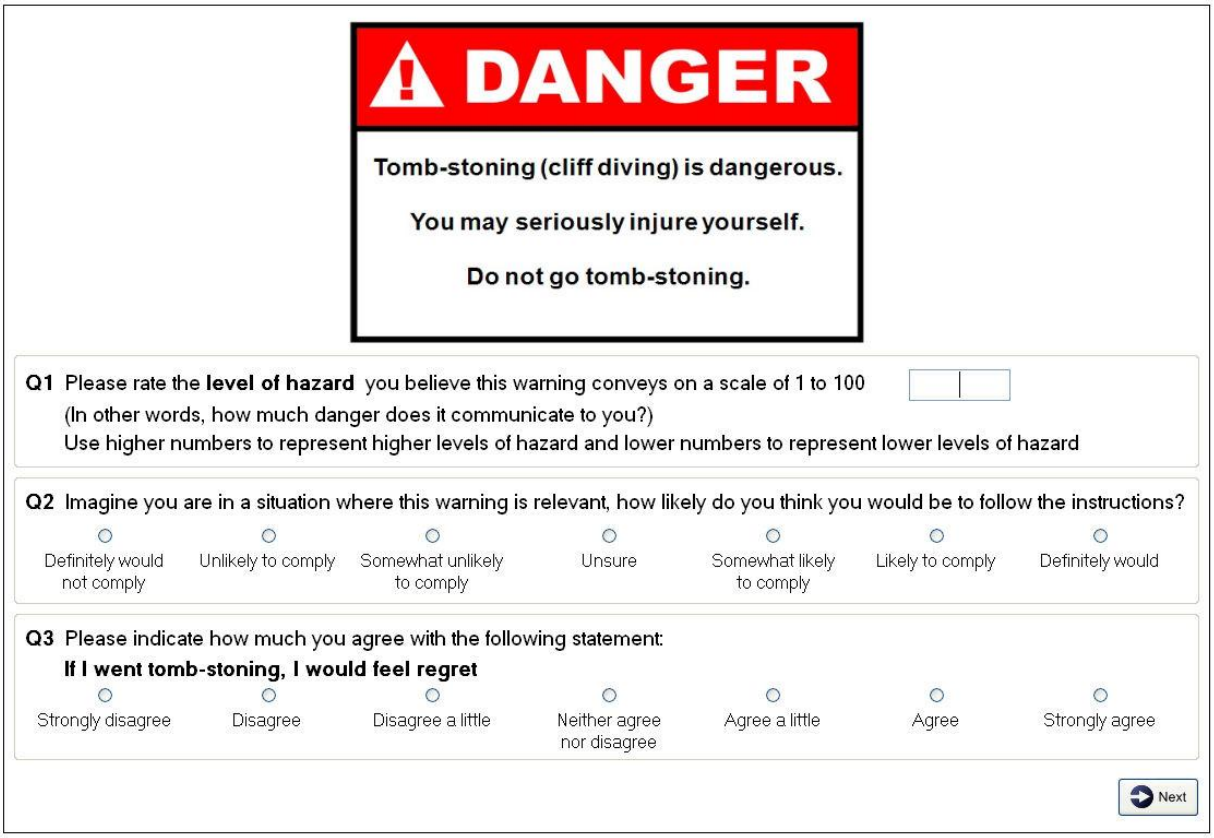




Appendix 5C Anticipated regret statements

1. If I regularly drank more than the recommended level of alcohol a week, I would feel regret
2. If I went down a ski run beyond my ability, I would feel regret
3. If I did not wear a high factor sunscreen when sunbathing, I would feel regret
4. If I broke the speed limit in a residential area, I would feel regret
5. If I did not use a pedestrian crossing when crossing a dual carriage way, I would feel regret
6. If I listened to music above 90dB for a prolonged period, I would feel regret
7. If I went tomb-stoning, I would feel regret
8. If I smoked marijuana, I would feel regret
9. If I had unprotected sex with someone I just met, I would feel regret
10. If I ran a red light at a train crossing, I would feel regret
11. If I swam at a beach unmanned by lifeguards, I would feel regret
12. If I walked home alone at night in an unsafe area, I would feel regret
13. If I drove when I felt drunk, I would feel regret

Appendix 5D Screen shot of a warning stimulus
taken from the main study



DANGER

Tomb-stoning (cliff diving) is dangerous.

You may seriously injure yourself.

Do not go tomb-stoning.

Q1 Please rate the **level of hazard** you believe this warning conveys on a scale of 1 to 100
(In other words, how much danger does it communicate to you?)
Use higher numbers to represent higher levels of hazard and lower numbers to represent lower levels of hazard

Q2 Imagine you are in a situation where this warning is relevant, how likely do you think you would be to follow the instructions?

Definitely would not comply	Unlikely to comply	Somewhat unlikely to comply	Unsure	Somewhat likely to comply	Likely to comply	Definitely would

Q3 Please indicate how much you agree with the following statement:
If I went tomb-stoning, I would feel regret

Strongly disagree	Disagree	Disagree a little	Neither agree nor disagree	Agree a little	Agree	Strongly agree

Next

Appendix 5E Warning task instructions

You will now be shown a series of **fictitious** warnings.

You will be asked **3 questions** about each warning

You may find this difficult as you may not have ever encountered or will never encounter warnings like the ones presented. The warnings may seem strange and may not depict a situation you would find yourself in.

Please try to ***imagine*** that you are in a situation where the warning is relevant when making your judgements.

You will be given three practice trials before the real task begins

There is no right or wrong answer. I want to know how YOU judge the warnings.

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